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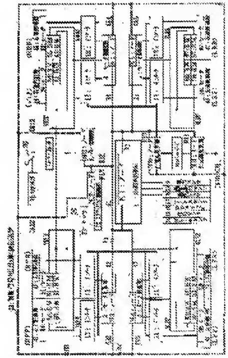
(54) CONTROL DEVICE OF ELECTRIC VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a control device for an electric vehicle which can transmit and receive control information, bypassing a faulty transmission line when nonconformities occur in some transmission line, by enabling signal transmission between each control device attached to each motor.
SOLUTION: An electronic control system for the electric vehicle is provided with a fail safe means for a signal transmission path, where a node that detects communication trouble sends a search message for searching a transmission path and a node capable of the formation of a transmission path sends back a response message thus forming a bypass circuit.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the electric vehicle with which two or more driving wheels are in one vehicle, and the motor for a drive per piece is attached in each of this driving wheel While the speed regulating device for making the electrical signal from the outside perform acceleration and moderation to each of said motor for a drive is attached It is based on a command from an operator or a mounted sensor at each of this speed regulating device. The control unit of the electric vehicle characterized by providing the main control unit which has the function to receive the situation of delivery, said motor for a drive, and said speed regulating device of operation for the control signal for acceleration and deceleration as a signal for control.
[Claim 2] The control unit of the electric vehicle characterized by containing each of the electrical potential difference of a cell, the current supplied from this cell, and cell temperature as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.
[Claim 3] The control unit of the electric vehicle characterized by including the piece angle of a steering as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.
[Claim 4] The control unit of the electric vehicle characterized by including the sensor signal which shows that it is under charge from charging equipment as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.
[Claim 5] The control device of the electric vehicle characterized by sensor ** rare ****** which shows the brake command value from a brake control section, and the oil pressure of a master cylinder as a sensor signal inputted into said main control unit in the control device of an electric vehicle according to claim 1.
[Claim 6] The control unit of the electric vehicle characterized by including the include-angle signal of a steering in the control unit of an electric vehicle according to claim 1 as a control signal sent from said main control unit.
[Claim 7] The control unit of the electric vehicle characterized by containing the control section which makes the control signal for deducing the location of a self-vehicle from a GPS sensor and map

information correctly, deducing the obstruction around said self-vehicle automatically by the obstruction sensor in the control unit for electric vehicles according to claim 1, and/or grasping the physical relationship of said self-vehicle and other vehicles by the communication link between ****, and performing actuation of acceleration and deceleration and a steering automatically based on such information.

[Claim 8] The control unit of the electric vehicle characterized by having the fail-safe means of the signal-transmission way which the retrieval message which the node which detected the communication failure in the electronic control system of a car searches for a transmission route is transmitted, and the node which can form a transmission line returns a response message, and forms a detour.

[Claim 9] It is the control unit of the electric vehicle characterized by consisting of a self-node ID storage means by which said node memorizes the identifier of a self-node in the control unit of an electric vehicle according to claim 8, an adjacent node ID storage means to memorize the identifier of the adjacent node connected to said transmission line, and a processing means to process routing based on the message sent to said node.

[Claim 10] It is the control unit of the electric vehicle characterized by being prepared in the motor control section which prepared said node for every car control section and wheel group in the control unit of an electric vehicle according to claim 9.

[Claim 11] It is the control device of the electric vehicle characterized by preparing said node in the cell control section, the steering control section, the brake control section, and the charge control section in the control device of an electric vehicle according to claim 9.

[Claim 12] The motor control section prepared for every said car control section and wheel group in the control unit of an electric vehicle according to claim 10 is the control unit of the electric vehicle characterized by controlling a converter by the control signal inputted through the node prepared in each.

[Claim 13] The control unit of the electric vehicle characterized by constituting said detour from a detour trunk transmission line for control signals which constitutes a closed loop, and a detour transmission line between this detour trunk transmission line and said each motor control section in the control unit of an electric vehicle according to claim 10 or 11.

[Claim 14] It is the control unit of the electric vehicle characterized by suspending actuation of said motor control section, detecting that said car control section does not have the response from said specific node, and separating the motor control section of said specific node from a control-section object when it detects that the failure generated the specific node in all the transmission lines between said car control sections, and detour transmission lines in the control unit of an electric vehicle according to claim 13.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the control unit of the electric vehicle which equipped the electronic control system of a car with the fail-safe means.
[0002]
[Description of the Prior Art] Development of a perfect electric vehicle is becoming pressing need as one conclusive factor of preventing the air pollution by motorization. Recognizing that maintenance of natural environment will be the big target in the 21st century, the artificer of this application will start from the 1980 time at the research, and is getting the result.
[0003] As shown in drawing 7 , only using the driving force of a motor 101, an electric vehicle is a vehicle it can run and is made to call the thing [thing / thing / using a rechargeable battery (dc-battery) as a power source supplied to the motor 101 / using an electric vehicle A and an engine generator in a narrow sense] using the series hybrid vehicle B and a fuel cell the fuel cell vehicle C. 102 -- for a rechargeable battery and 201, as for a generator and 301, an engine and 202 are [a wheel and 103 / a controller and 104 / a hydrogen source of supply and 302] fuel cells.
[0004] Thus, an electric vehicle is defined as the vehicle which used things which combined these, such as a generator, a solar battery, etc. using the rechargeable battery, the fuel cell, and the internal combustion engine as a power source which is the vehicle it can run and is supplied to the electric motor, only using the driving force of a rotating type electrical-and-electric-equipment motor. However, although the electric vehicle which used only the rechargeable battery is borne in mind in the following explanation, naturally the vehicle which makes a power source a fuel cell, an internal combustion engine generator, and a solar battery is also included.
[0005] In order to raise the safety and facility of operation of a car, a component with the gradually redundant electronic system which poses an insurance top problem of a car, for example, a sensor, and a computer element are carried increasingly.
[0006] For example, the example in which a position sensor or a rotational frequency sensor of an operational operating member etc. is formed in redundancy by the operator is introduced. The signal of the measuring device constituted by this redundancy is supplied to two processors which control the drive output of a car based on the respectively almost same computer program. The output signal of both processors acts on the same good variate which affects the output of the drive unit of a car in that case.
[0007] However, if this kind of system is completely made into redundancy, it will become remarkably complicated, and by it, cost will increase and the frequency of failure will also increase.
[0008] Two or more electronic control units are carried in the current car as known. A speed-control unit, a steering control unit, etc. are mentioned especially. These control units act on other good variates of the drive unit of a car, respectively.
[0009] In a current car, an electronic connection system connects mutually and these control units exchange data and information mutually through it.
[0010] Especially speed control of an electric vehicle has the simplest method of passing the electric signal from an accelerator pedal to the control unit which controls the current passed to a motor. Moreover, it is the case where two or more motors are used for a drive, and in controlling acceleration of a vehicle, moderation, and turn combination, it needs one more central control unit which controls the whole vehicle. Until now, in such a control unit, between a central control unit and the control units attached in each motor was connected with the signal line, respectively, and control was performed.
[0011]
[Problem(s) to be Solved by the Invention] However, by the approach of such control, when un-arranging arises in each communication wire, it becomes impossible to control each motor.
[0012] This invention makes a signal transmission possible also between the control units attached in each motor in view of the above-mentioned situation, and aims at offering the control unit of the electric vehicle which detours when un-arranging arises in one of the transmission lines, and can transmit and receive control information.
[0013]

[Means for Solving the Problem] In the electric vehicle with which two or more driving wheels are in 1] 1 vehicle, this driving wheel resembles it, respectively, and the motor for a drive per piece is attached in it in order that the invention in this application may attain the above-mentioned purpose -- [-- While the speed regulating device for making the electrical signal from the outside perform acceleration and moderation to each of said motor for a drive is attached It is characterized by providing the main control unit which has the function to receive the situation of delivery, said motor for a drive, and said speed regulating device of operation for the control signal for acceleration and deceleration as a signal for control based on the command from an operator or a mounted sensor to each of this speed regulating device.

[0014] [2] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by containing each of the electrical potential difference of a cell, the current supplied from this cell, and cell temperature as a sensor signal inputted into said main control unit.

[0015] [3] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the piece angle of a steering as a sensor signal inputted into said main control unit.

[0016] [4] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the sensor signal which shows that it is under charge from charging equipment as a sensor signal inputted into said main control unit.

[0017] [5] In the control device of the electric vehicle of the above-mentioned [1] publication, it is characterized by sensor ** rare ****** which shows the brake command value from a brake control section, and the oil pressure of a master cylinder as a sensor signal inputted into said main control unit.

[0018] [6] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the include-angle signal of a steering as a control signal sent from said main control unit.

[0019] [7] In the control unit for electric vehicles of the above-mentioned [1] publication, the location of a self-vehicle is correctly deduced from a GPS sensor and map information, the obstruction around said self-vehicle is automatically deduced by the obstruction sensor, and/or the physical relationship of said self-vehicle and other vehicles is grasped by the communication link between ****, and it is characterized by containing the control section which makes the control signal for performing actuation of acceleration and deceleration and a steering automatically based on such information.

[0020] [8] It is characterized by having the fail-safe means of the signal-transmission way which the retrieval message which the node which detected the communication failure in the electronic control system of a car searches for a transmission route is transmitted, and the node which can form a transmission line returns a response message, and forms a detour.

[0021] [9] In the control unit of the electric vehicle of the above-mentioned [8] publication, said node is characterized by consisting of a self-node ID storage means to memorize the identifier of a self-node, an adjacent node ID storage means to memorize the identifier of the adjacent node connected to said transmission line, and a processing means to process routing based on the message sent to said node.

[0022] [10] In the control unit of the electric vehicle of the above-mentioned [9] publication, said node is characterized by being prepared in the motor control section prepared for every car control section and wheel group.

[0023] [11] In the control device of the electric vehicle of the above-mentioned [9] publication, said node is characterized by being prepared in the cell control section, the steering control section, the brake control section, and the charge control section.

[0024] [12] In the control unit of the electric vehicle of the above-mentioned [10] publication, the motor control section prepared for every said car control section and wheel group is characterized by controlling a converter by the control signal inputted through the node prepared in each.

[0025] [13] In the control unit of an electric vehicle the above [10] or given in [11], it is characterized by constituting said detour from a detour trunk transmission line for control signals which constitutes a closed loop, and a detour transmission line between this detour trunk transmission line and said each motor control section.

[0026] [14] In the control unit of the electric vehicle of the above-mentioned [13] publication, when it detects that the failure generated the specific node in all the transmission lines between said car control sections, and detour transmission lines, actuation of said motor control section is suspended, and it detects that said car control section does not have the response from said specific node, and is characterized by separating the motor control section of said specific node from a control-section object.

[0027]
[Embodiment of the Invention] It has the wheel system which serves as an example of representation in the gestalt of operation of the following and this invention while refer to a drawing and by which two flowers are support each in a tandem wheel mounted suspension , has the driving wheel of six or more flowers , and is carry in the electric vehicle which considered each driving wheel as the Inn wheel mounted drive , and the embodiment of this invention which applies a fail-safe device to each control unit which carries out motor control so that the transit stability at the time of a slip may be raise is explain .
[0028] The description of this invention is in the fail-safe means in a control system equipped with an electronic control unit, and the control system and equipment of the complementary become suitably applicable.
(1) System configuration drawing 1 is the system configuration Fig. of the electric vehicle in which the example of this invention is shown.
[0029] It is not necessary to be the wheel system by which order both wheels were supported in the tandem wheel mounted suspension, and you may be the wheel system by which only the wheel system of before or the back was supported in the tandem wheel mounted suspension in this invention.
[0030] The electric vehicle in this embodiment is an eight-flower drive electric vehicle of an in wheel motor mold. That is, it is each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which has the wheel system supported in a tandem wheel mounted suspension, and built the motor into all wheel rings.
[0031] Thus, by constituting, the support load for every wheel can be lessened, TRC (trademark) corresponding to it or ABS control can be performed, a slip etc. can be lessened, and transit stability can be raised.
[0032] When the transducer which can drive according to various kinds of power sources, such as an alternating current, a direct current, and a pulse, and corresponds according to the class of the power source, for example, a power source, is an alternating current, a transducer is an inverter, each motor is a converter when it is a direct current, and when it is a pulse, it is a chopper etc.
[0033] An alternating current explains an embodiment in case a transducer is the following and a power source is an inverter.
[0034] The car control section 1 is equipped with a microcomputer, inputs the detection information from various sensors, performs required processing, and outputs a control command to each motor control section. Said control command from the car control section 1 minds transmission lines R1, R2, R3, R4, R5, R10, R11, R12, and R13, the detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13, and the detour trunk transmission line CR for control signals. It is outputted to each motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22.
[0035] Moreover, the car control section 1 consists of control of the output torque of each motors 30, 31, 32, 33, 34, 35, 36, and 37, revolving speed control, speed control, house keeping and control of mounted each component, the information of the car condition to car crew, electric supply control of a dc-battery, charge control of a dc-battery, brake control, steering control, and an electronic control unit (ECU) that bears other functions, and has a micro program for processing for performing said function. furthermore, to the car control section 1 The power sensor 9 for the electrical-potential-difference value and current value detection of the rotation position sensors 50, 51, 52, 53, 54, 55, 56, and 57 and a dc-battery, the brake sensor 14 which detects actuation of a brake, the rudder angle sensor 15 which detects the steering angle of a handle, and the shift position of a shift lever The detection output of the abnormality detection

sensor 19 which detects that the temperature sensor 18, and the electrical-potential-difference value and current value of a converter which detect the shift position switch 16 to detect, the accelerator sensor 17 which detects the opening of an accelerator, dc-battery temperature, converter temperature, etc. fell from the threshold etc. is inputted.

[0036] The rotation position sensors (for example, resolver) 50, 51, 52, 53, 54, 55, 56, and 57 prepared for every wheel generate the signal (for example, the minute angular position pulse signal for every variation rate) which shows the wheel speed VRFF, VRFR, and VLFF, VLFR, VRRF, VRRR, VLRF, and VLRR of each wheel, and supply it to the car control section 1.

[0037] The accelerator sensor 17 makes the signal with which a shift position switch 16 shows the signal with which the brake sensor 14 shows the amount of treading in of a brake pedal 20 for the signal which shows the amount of treading in of an accelerator pedal (not shown), the injection range (the engine brake range shift-lever location [And] within the range concerned), i.e., the shift position, of a shift lever (not shown), output, respectively. The rudder angle sensor 15 makes the signal which shows signal, for example, rudder angle, deltat which shows the result of rudder angle detection of a handle output. The power sensor 9 of a dc-battery measures and outputs the electrical-potential-difference value and current value of a dc-battery. A temperature sensor 18 measures and outputs the temperature of devices, such as an inverter. The abnormality detection sensor 19 is outputted with abnormalities, when the electrical-potential-difference value and current value of an inverter turn into below a threshold.

[0038] In inputting into the car-body control section 1, each output of these sensors is changed into the data of a format which can be processed by the car control section 1. The car control section 1 performs the decision of a torque command, a rotational frequency command, a rate command, etc., a switch of the control approach, etc. using the data after conversion. Hereafter, the embodiment of a torque control is explained as instantiation.

[0039] Each motor control sections 2, 3, 4, and 5 are equipped with a microcomputer, input the control command from the car control section 1 through a transmission line, carry out required processing, and they are constituted so that a control command may be outputted to inverter 10, 10', 11, 11', 12, 12', 13, and 13'. According to the torque command TRF, the motor control section 3 controls inverter [with which the motor control section 5 corresponds according to the torque command TLR according to the torque command TRR respectively according to the torque command TLF in the motor control section 4] 10, 10', 11, 11', 12, 12', 13, and 13', and the motor control section 2 carries out the torque control of the motors 30, 31, 32, 33, 34, 35, 36, and 37. All torque commands given to the motor control sections 2, 3, 4, and 5 are outputted from the car control section 1. Control of inverter 10 and 10', 11, 11', 12, 12', 13, and 13' is performed based on each phase current estimate of the motor for which it asked from the Rota angular position etc. based on each phase current detection value of the motor obtained from the current sensor which is not illustrated. [to each motors 30, 31, 32 33, 34, 35 36, and 37]

[0040] As for the wheel system supported in a tandem wheel mounted suspension, motors 30, 31, 32, 33, 34, 35, 36, and 37 are built into the forward right section front wheel RFF40, the forward right section rear wheel RFR41, the forward left section front wheel LFF42, the forward left section rear wheel LFR43, the right rear section front wheel RRF44, the right rear section rear wheel RRR45, the left posterior part all ring LRF46, and the left rear section rear wheel LRR47, respectively.

[0041] A dc-battery 6 is a drive power source of supply to each motor, and electric power is supplied to the output by motors 30 and 31 on motors 36 and 37 through motors 34 and 35 and an inverter 13, and 13' at motors 32 and 33 through an inverter 12 and 12' through an inverter 11 and 11', respectively through an inverter 10 and 10'. In order to output a dc-battery 6 to the basis of control of the motor control section 2 controlled by the car control section 1 and to output a torque control, speed control, etc. on motors 30 and 31, the power of an inverter 10 and 10' is converted (it changes into the three-phase alternating current in this drawing), and they supply electric power. Inverter 11, 11', 12, 12', 13, and 13' operates similarly.

[0042] In drawing 1 , the braking system which brakes tandem-type front and rear, right and left particulars by both oil pressure and regeneration is used by the design plan which secures safety.

[0043] That is, if a brake pedal 20 is stepped on, the oil pressure generated in the master cylinder 21

according to this will act on the brake foil BW60, BW61, BW62, BW63, BW64, BW65, BW66, and BW67 through the foil cylinder prepared in each wheel, and damping torque will be given to a wheel.
[0044] It is inputted into the car control section 1 by the transmission line where the detecting signal according to the brake force (oil pressure of a master cylinder 21) FB detected using the brake sensor 14 minded the node N12 on the other hand, and the car control section 1 generates the torque commands TRF, TLF, TRR, and TLR which start regeneration based on said detecting signal. A regeneration command turns into the command according to a control command, for example, a torque command, a rate command, etc.
[0045] Therefore, the braking force distribution in the car of drawing 1 turns into allocation to which both oil pressure regeneration increases with increase of a brake force FB. Thus, since a hydraulic system and a regeneration network dissociate after the brake sensor 14 and are further backed up by the transmission line, even if oil pressure and either of the regeneration malfunction, a car can be evacuated on the other hand.
[0046] Furthermore, since it is [that the proportioning valve for a pump not being formed in a hydraulic system and distributing oil pressure damping force forward and backward as a bulb is only prepared, and], a system configuration becomes simple. In addition, one of the reasons which does not need to form a pump in a hydraulic system and can hold down the number of the bulb on a hydraulic system to minimum again is in the characteristic configuration of this operation gestalt of performing transit stability control using control of the output torque of motor 12FR, 12floor line, 12RR, and 12RL(s), like the after-mentioned.
[0047] The detour trunk transmission line CR for control signals where the failsafe device used as the description of this invention constitutes a closed loop Each motor control sections 2, 3, 4, and 5 from this detour trunk transmission line CR, the cell control section A The detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13 connected to the charge control section B, the brake control section C, and the steering control section 22, Each motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22, It consists of transmission lines which connect the car control section 1 which controls the whole, and each of this motor control section, the cell control section A, the charge control section B, the brake control section C2, the steering control section 22 and the car control section 1.
(2) Fundamental control drawing 6 of a car is a flow chart which shows the operations sequence of the car control section which shows the example of this invention.
[0048] The car control section 1 performs detection of car body speed VS first (step S1).
[0049] Although various procedures as a detection procedure of car body speed VS are employable, it is desirable to, adopt a procedure as shown in drawing 3 for example. Hereafter, the flow chart of drawing 3 shows the procedure of detecting car body speed VS. In this drawing, the car control section 1 reads the detection value V of the wheel speed sensor SM every two flowers as one set which has tandem construction first (step S30), and calculates that wheel angular-acceleration d omega/dt (step 31). As operation expression of wheel angular acceleration, following formula d omega/dt <- (1/R) and dV/dt can be used. R is a wheel radius among an upper type, and V and omega are the wheel speed and wheel angular velocity concerning the wheel which is going to ask for current wheel angular acceleration.
[0050] The absolute value of wheel angular-acceleration d omega/dt for which carried out in this way and it asked has exceeded the predetermined threshold, or the car control section 1 compares about the above-mentioned one set. When the absolute value of wheel angular-acceleration d omega/dt has exceeded both of thresholds among one set (all rings), it judges with a slip (SL). Although one of one sets has exceeded the threshold, when one more flower does not exceed a threshold The wheel speed V of the direction which does not exceed a threshold while judging un-slipping (SX) is held as wheel speed of the set. When the wheel angular acceleration of domega / absolute value of dt does not exceed both of thresholds among one set (all rings), while judging with un-slipping (SX), the wheel speed of a large value is held as wheel speed of the set (step S32).
[0051] When the one-set wheel is judged with un-slipping (SX), the wheel speed V of the wheel is integrated to Variable VS (step S33). on the contrary, when you judge the one-set wheel with a slip, the

absolute value of angular-acceleration d omega/dt has exceeded the predetermined threshold -- it is rich, and since [which can be made] a slip or its inclination has occurred about ** and its wheel, one increment of NS(s) which are a variable for counting the number of the wheel (slip ring) which can be regarded as a slip or its inclination having arisen is carried out (step S34).
[0052] After the car control section 1 performs step S33 or S34, it is memorized in the memory which builds in the location and wheel speed V of the one-set wheel (step S35). The car control section 1 performs the procedure concerning steps S31-S35 about all the driving wheels containing the wheel of all tandem construction (step S36).
[0053] After it carries out the car control section 1 in this way and it performs the judgment of a slip ring, or an it and a non-slipping ring about all driving wheels, it judges whether is so in whether any whether the number NS of a slip ring being equal to 4 and driving wheels have slipped (step S37). usually, the value with which the car control section 1 was integrated by VS by repeat activation of step S33 in order that, as for an example, all driving wheels might not make a slip or its inclination coincidence -- the number of 4-NS, i.e., a non-slipping ring, -- **** -- car body speed VS is computed by things (step S38).
[0054] On the contrary, when NS=4 are materialized, it searchs which wheel the driving wheel which began to slip at the end is using the information memorized when step S35 was performed in the past (step S39).
[0055] The car control section 1 presupposes that the value of the wheel speed V which it had just before the wheel which began to slip, the driving wheel, i.e., last, discovered as a result of this search, begins to have slipped is used as car body speed VS (step S40).
[0056] Thus, in this operation gestalt, the torque command value by which temporary decision is carried out is made suitable in the procedure which makes it possible to determine car body speed VS comparatively correctly, as a result is mentioned later by asking for car body speed VS only from the wheel speed of a non-slipping ring in principle. moreover, since it is tandem suspension structure, it will be called a very rare condition that all eight wheels show a slip or its inclination, but since it is considering as car body speed VS also then with the average of the wheel speed which it had in a predetermined within a time one from from just before the wheel which began to slip at the end begins to slip, the car body speed information which can set dependability comparatively can use for temporary decision of a torque command value. After step S38 or S40 activation, actuation of the car control section 1 returns to step S2 of drawing 6 .
[0057] In drawing 6 , after detecting car body speed VS, in order to judge the condition of steering first, the absolute value of rudder angle deltat is the same as a predetermined threshold, or that judgment is performed more than it (step S2). By the case where a rudder angle is larger than a threshold, when there is no slip (step S12), the car control section 1 performs adaptation control (for example, whenever [angle-of-slide] 0 control) whenever [target yaw REITO adaptation control or target angle-of-slide] (step S3).
[0058] For example, when the absolute value of rudder angle deltat detected by the rudder angle sensor 15 is beyond a predetermined threshold (i.e., when it is judged that the car pilot is steering), adaptation control is performed [that generating of the transit instability of the car body accompanying steering should be prevented thru/or controlled] whenever [target yaw REITO adaptation control thru/or target angle-of-slide].
[0059] An example of the procedure of adaptation control is shown in drawing 4 whenever [target yaw REITO adaptation control thru/or target angle-of-slide].
[0060] In the flow shown in drawing 4 , the car control section 1 has chosen the coupling-coefficient group (formula based on experience) based on ddeltat/dt computable based on rudder angle deltat and this which are given from the accelerator-on / OFF state which can be first judged based on the output of the accelerator sensor 17, the shift position given by the shift position switch 16, and the rudder angle sensor 15 etc. (step S50).
[0061] The car control section 1 calculates the road surface coefficient of friction mu (formula based on experience) further based on this in quest of wheel acceleration dv/dt for every wheel of tandem

suspension structure (step S51). The car control section 1 determines a correction factor k for every wheel using the coupling-coefficient group chosen at step S50 based on the road surface coefficient of friction mu and rudder angle deltat (step S52).

[0062] The car control section 1 carries out temporary decision of the torque command for every wheel from a power running torque map based on (step S53), wheel speed V, the accelerator opening VA, and a shift position, when the accelerator turns on (step S54). Moreover, when the accelerator turns off, based on (step S53), wheel speed V, a brake force FB, and a shift position, temporary decision of the torque command is carried out for every wheel from a regeneration torque map (step S55). A rotational frequency and torque are the maps showing the rotational frequency torque characteristic of the motor in a forward field, both power running torque maps are maps which forward and torque show the rotational frequency torque characteristic of the motor in a negative field, and the rotational frequency asks them for the regeneration torque map by experience.

[0063] By multiplying by the correction factor determined as the torque command which carried out temporary decision at step S52 in step S54 or S55, the car control section 1 opts for a torque command (step S56), and outputs the determined torque command to the corresponding motor control section (step S57).

[0064] Therefore, according to the setting technique of the value of the coupling-coefficient group which serves as a candidate for selection at step S50, and the correction factor k in step S52, the range which a torque command when performing adaptation control whenever [target yaw REITO adaptation control thru/or target angle-of-slide] can take may serve as the value which may turn into a value belonging to the time of accelerator-on, or a regeneration field, and belongs to a power-running field also in the time of accelerator-off. By performing such control, the transit stability of the car body at the time of steering is raised with this operation gestalt.

[0065] In addition, please refer to the indication of JP,10-210604,A about adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide]. Moreover, it may replace with adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide], and the technique of performing transit stability control using two or more quantity of states which show the movement conditions of a car including yaw REITO which acts on a car body may be adopted.

[0066] Please refer to JP,10-271613,A about this technique. After ending adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide], actuation of the car control section 1 returns to drawing 6 .

[0067] The car control section 1 repeats return actuation to step S1. Moreover, in step S2 performed after detecting car body speed VS, when the absolute value of a rudder angle is smaller than a threshold when it is admited that it is not necessary to perform adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide] namely, the car control section 1 performs the procedure which starts 8WD control in principle (step S6).

[0068] The car control section 1 is faced starting this 8WD control step S6, and performs judgment / classification processing about the number NS of the slip ring corresponding to one set of wheels in the tandem suspension structure first detected in the procedure of detecting car body speed VS.

[0069] Namely, the time (step S7) of all driving wheels showing a slip or its inclination, when the number NS of the detected slip ring is equal to 4, When the number NS of a slip ring is equal to 3 (step S8) (i.e., when there is only one driving wheel (one set) of the tandem suspension structure which does not show a slip or its inclination) Actuation of the car control section 1 shifts to the TRC/ABS equivalent control instead of 8WD control (step S6) (step S9).

[0070] Moreover, even if it is a time (step S10) of two driving wheels of the tandem suspension structure which does not show a slip or its inclination existing when the number NS of a slip ring is equal to 2 namely, when [both] both the detected slip rings are left-hand side wheels. in being a right-hand side wheel (step S11), it shifts to TRC/ABS equivalent control (step S9).

[0071] furthermore -- even if it is a time of being judged with it being in the condition that adaptation control is regarded as the need in the above-mentioned step S2 whenever [target yaw REITO adaptation control thru/or target angle-of-slide] -- the number NS of a slip ring -- un--- the time of it being admited

that the driving wheel of one of tandem suspension structures shows a slip or its inclination when it is 0 -- (step S12) -- it shifts to TRC/ABS equivalent control too (step S9).

[0072] An example of the procedure of TRC/ABS equivalent control is shown in drawing 5 .

[0073] Facing performing TRC/ABS equivalent control, the car control section 1 chooses a coupling-coefficient group, a controlled parameter group, etc. first according to the height of the wheel speed V of each wheel, accelerator-on / OFF, etc. (step S60).

[0074] It is the set of the multiplier used in order to use a coupling-coefficient group here for the below-mentioned angular-acceleration judging, to come, to be and to determine a value group, and a controlled parameter group is the set of the constant used in case feed back torque is determined. In step S61, the car control section 1 carries out temporary decision of (step S63) and the torque command from a regeneration torque map according to wheel speed V, a brake force FB, and a shift position, when the accelerator turns on and (step S62) and an accelerator turn off from the power running torque map according to wheel speed V, the accelerator opening VA, and a shift position.

[0075] Further, the car control section 38 determines a threshold group based on the coupling-coefficient group chosen at the accelerator opening VA and step S60, when the accelerator turns on in step S61 (step S64). Moreover, when the accelerator turns off, a threshold group is determined based on a brake force FB and the coupling-coefficient group chosen at step S60 (step S65).

[0076] The car control section 1 classifies the angular acceleration of domega of each wheel / dt on the basis of the threshold group determined in step S64 or S65 (step S66). The car control section 1 determines feedback torque using different operation expression etc. according to the result of a classification. for example, wheel angular-acceleration d omega/dt -- the 1st range -- a group -- then -- coming -- being alike -- the feedback torque decision processing by the 1st operation expression -- (step S67-1) -- the 2nd range -- a group -- then -- coming -- being alike -- the feedback torque decision processing based on the 2nd operation expression -- (step S67-2) -- the 3rd range -- a group -- then -- coming -- being alike -- the feedback torque decision processing by the 3rd operation expression -- (step S67-3) -- the -- n-th range -- a group -- then -- coming -- being alike -- the feedback torque decision processing based on the n-th operation expression -- as -- (step S67- n) feedback torque is determined in the operation expression according to the range in which the angle-of-rotation acceleration of domega / dt belongs for every wheel.

[0077] furthermore, step S67-1 and S -- 67-2, S67-3, and ... let the constant in the operation expression concerning step S67-n be a value concerning the controlled parameter group chosen at step S60. By reducing the feedback torque which carried out in this way and was determined in step S62 or S63 from the torque command value which carried out temporary decision, the car control section 1 decides a torque command value (step S68), and outputs the settled torque command value to the corresponding motor control section (step S69).

[0078] By adopting such a procedure, the torque which acts on each driving wheel can be fluctuated suitably, and the function equivalent to the TRC/ABS control in a native engine car can be realized. In addition, please refer to the indication by JP,8-182119,A and JP,10-210604,A about TRC/ABS equivalent control. After ending the procedure shown in drawing 5 , actuation of the car control section 1 shifts to step S4 shown in drawing 6 .

[0079] When, as for the car control section 1, no shift conditions to adaptation control and shift conditions to TRC/ABS equivalent control are satisfied whenever [target yaw REITO adaptation control thru/or target angle-of-slide], Namely, the absolute value of rudder angle deltat does not turn into more than a threshold, but the number NS (number of sets) of the slip ring of tandem suspension structure is two or less. And when all two left-hand side wheels or two right-hand side wheels are not a slip ring, the procedure concerning 8WD control (step S6) is performed.

[0080] In that case, the car control section 1 judges first whether the number NS of the above-mentioned slip ring is 1 (step S13). On the usual transit way, since it is NS=0, actuation of the car control section 1 shifts to steps S14 and S15. At step S14, the car control section 1 determines all the driving wheels of tandem suspension structure as an allocation ring. An allocation ring here is a driving wheel which actually distributes a torque output. At step S15, the car control section 1 usually sets the specific gravity

of allocation of the torque output to each allocation ring as a value. For example, specific gravity =1 of allocation is set up to all driving wheels. However, the specific gravity of this allocation may be changed according to car loading weight, and is not cared about as predetermined specific gravity which is different between the wheels of order according to the structure of a car body. [0081] On the contrary, when it judges with it being NS=1 in step S13, or when it is judged with the shift conditions to TRC/ABS equivalent control not being satisfied in step S11, wheels other than a car control-section 1 slip ring are determined as an allocation ring (step S16).
[0082] Furthermore, when torque is actually outputted, the allocation specific gravity to each car is adjusted so that the moment of the direction of a yaw centering on a car-body center of gravity will not newly act on a car body, namely, so that right and left may balance (step S17).
[0083] For example, allocation specific gravity is set to 0 so that a torque command may not be given, the driving wheel, i.e., the slip ring, which was not chosen as the allocation ring in step S16, and if it has not slipped, the allocation specific gravity equivalent to the torque output which must have been distributed to the slip ring is added to the allocation specific gravity of the non-slipping ring of the side to which a slip ring belongs among left-hand side and right-hand side.
[0084] If the accelerator turns on the car control section 1 and (step S19) and an accelerator turn it off from the power running torque map in step S18 according to car body speed VS, the accelerator opening VA, and a shift position after it performs step S15 or S17, it will carry out temporary decision of the torque command from a regeneration torque map according to car body speed VS, a brake force FB, and a shift position (step S20).
[0085] After the car control section 1 performs step S19 or S20, it is adjusted to the torque command value which carried out temporary decision in step S19 or S20 according to the allocation specific gravity which is step S15 or S17, and is set up thru/or adjusted beforehand (carrying out the multiplication for example, of the allocation specific gravity), and, thereby, decides the torque command value over each wheel (step S21).
[0086] The car control section 1 outputs each torque command value decided at step S21 to the motor control section which corresponds, respectively (step S22), and shifts to step S4 after that.
[0087] Therefore, with this operation gestalt, a control state changes according to the slip condition of each wheel of tandem suspension structure. First, if two flowers of tandem suspension structure are made into one unit, when only one of four wheels has slipped (i.e., when it is NS=1), the torque command which must have been carried out with the slip ring concerned if it had not slipped will be outputted in other driving wheels in the same side as this slip ring. Moreover, when the slip ring exists at a time in one right and left while at the time of being NS=2 similarly, a torque command is realized with the non-slipping ring which remains one right and left at a time. Furthermore, it is NS=2, and when each slip ring is in left-hand side (or right-hand side), TRC/ABS equivalent control is performed. Furthermore, when it is NS=3, or when it is NS=4, TRC/ABS equivalent control is performed too. thus , since he be try to switch or change the torque allocation specific gravity to the control mode and each wheel of each motor output by the car control section 1 according to the number and the location of the slip in each wheel or the generating situation of the inclination , especially a slip ring , suitable 8WD control and TRC/ABS equivalent control can realize in the eight flower drive electric vehicle of a foil in motor mold , and , according to this operation gestalt , the maintenance improvement of the transit stability can carry out .
(3) Since main electronic control units are connected through the detour trunk transmission line CR for control signals as the failsafe device above, also when a failure occurs in a transmission line etc., a control system can be backed up, and control of a passage can usually be performed.
[0088] A signal-transmission system is constituted based on the node (communication device) prepared in the car control section 1 which forms an electronic control unit, the motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22. Self-node ID storage means N1b each node (communication device) remembers the identifiers N1, N2, N3, N4, N5, N10, N11, N12, and N13 of a self-node to be, N2b, N3b, N4b, N5b, N10b, N11b, N12b, and N13b. Adjacent node ID storage means N1c which memorizes the identifier of

the adjacent node connected to the transmission line and the detour transmission line, N2c, N3c, N4c, N5c, N10c, N11c, N12c, and N13c. It is based on the message sent to a node. Processing of routing The transmission lines R1, R2, R3, R4, R5, and R10 which connect them with two or more nodes N1, N2, N3, N4, N5, N10, N11, N12, and N13 which had processing means N1a to perform, N2a, N3a, N4a, N5a, N10a, N11a, N12a, and N13a, respectively. The alternate-route setting method which consists of R11, R12, R13, detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13, and a detour trunk transmission line CR for control signals, bypasses the generated failure part, and sets up a communication path is taken.

[0089] According to the above-mentioned alternate-route setting method, each node by polling between the adjacent nodes through the transmission line and detour transmission line which were connected The node which detected as a failure of the communication link in the transmission line or detour transmission line between both when there was no response from a partner, and detected said communication failure The node which transmitted the self identifier and the identifier of the adjacent node connected to the transmission line where said communication failure was detected as a retrieval message s, and received said retrieval message If neither is in agreement as compared with the identifier memorized by the self-node ID storage means of self, or the adjacent node ID storage means as a result of said comparison, the identifier D of said adjacent node in said retrieval message The node which received said retrieval message relays said retrieval message to other nodes. and on the other hand, if either is in agreement as a result of said comparison, the node which received said retrieval message will be returned to the node which detected said communication failure for response message r for a detour setup.

[0090] Message classes, such as a retrieval message and a response message, and a transmission place communication device identify the retrieval message s and response message r to the control section of the frame of a sending signal, and they put the identifier (ID) of (ID) and a transmitting agency communication device, the identifier (ID) of a failure related communication device, the circuit remaining capacity, etc. on it. A failure related communication device points out the adjoining communication device connected to the transmission line which has generated the communication device which has generated the failure, or the failure.

[0091] If each node detects that the transmission line between the node N1 of the car control section 1 and the node Nn of each motor control section was securable, each node will set the self-motor control section and a self-inverter as a standby condition. When a control command inputs through a transmission line, the self-motor control section controls a self-inverter by the control command.

[Example (a)] For example, the case where communication failure B1 occurs on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .

[0092] By polling between the adjacent nodes N1 through the transmission line and detour transmission line which were connected, a node N2 is detected as a communicative failure, when there is no response from a partner. A message class is the retrieval message s, and the identifier of a transmitting agency communication device is N2, and processing means N2a of a node N2 puts the signal of the purport whose identifier of a failure related communication device is N1 on the control section of a signal frame, and transmits to it a node N13 or N3.

(a-1) Explain a setup of the detour through a node N3 first. If this retrieval message s is received, a node N3 takes out the identifier N1 of a failure related node from the retrieval message s in processing means N3a. and compares this identifier N1 with the data N1, N2, and N10 memorized by the data N3 and adjacent node ID storage section N3c which were memorized by self-node ID storage section N3b. Since an identifier N1 is in agreement with the data N1 memorized by adjacent node ID storage section N3c as a result of this comparison While transmitting response message r to a node N2 so that a node N3 may be connected to the transmission line R1 between a node N2 and a node N1, i.e.. a detour transmission-line CR2 -> detour trunk transmission-line CR-> detour transmission-line CR3 -> node N3 -> transmission-line R3 -> transmission line, the path change section of self is received. The routing signal which directs to set up the alternate route to a node N2 via a node N3 instead of the

communication path to the node N2 which goes via a transmission line R2 is sent.
[0093] Response message r is the sending signal which put the signal of the purport whose identifier of a transmitting agency node a message class is a response message, the identifier of a transmission place node is N2, and is N3 on the control section of a signal frame.
[0094] If the node N2 which received response message r on the other hand receives response message r, the signal of the purport whose identifier of a transmitting agency communication device is N3 will be taken out, the node of the partner who should set up an alternate route based on this will be checked, and the routing signal which directs to set up the alternate route to a node N3 as well as the above-mentioned embodiment will be sent to the path change section of self.
(a-2) Explain a setup of the detour through a node N13.
With the procedure explained above (a-1) and the same procedure, the detour connected with the detour transmission-line CR2 -> detour trunk transmission-line CR-> detour transmission-line CR13 -> node N13 -> transmission-line R13 -> transmission line R1 is formed.
[0095] An alternate route is set up based on the above two routing signals.
[Example (b)] For example, the case where the communication failure of B-2 occurs in the communication failure of B1 and the detour trunk transmission line CR on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .
[0096] In this case, only the detour explained above (a-2) can be set up, and the detour explained above (a-1) cannot be set up.
[Example (c)] For example, the case where B-2 and the communication failure of B3 occur in the communication failure of B1 and the detour trunk transmission line CR on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .
[0097] In this case, according to B1, B-2, and communication failure generating of B3, when there is no response to polling into predetermined time about all the transmission lines to the car control section 1 having been lost, a node N2 detects a node N2, it changes the standby mode of the motor control section 2 into stop mode, and stops an inverter 10 and 10'.
[0098] The car control section 1 detects that there is no response from a node N2 into predetermined time, separates a node N2 from a propagation circuit, backs it up through the remaining nodes, and controls the remaining motor control section.
[0099] Hereafter, the detour of the car control section 1 and each control sections 2, 3, 4, 5, 10, 11, 12, and 13 is set up like the above-mentioned embodiment.
[0100]
[Effect of the Invention] As mentioned above, according to this invention, the following effectiveness can be done so as explained to the detail.
[0101] (1) The electronics control which can improve transit stability is adopted and it has the wheel system supported in a tandem wheel mounted suspension, and the control action of a car can be continued, maintaining a control function by setting up an alternate route, even if the failure generated each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which built the motor of electronics control into all wheel rings in the specific electronic control system.
[0102] (2) Since the fail-safe device was included in the electronic control system, car control can be carried out to stability. That is, since the support load for every ring can be lessened since the control which can improve transit stability was adopted in each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which has the wheel system supported in a tandem wheel mounted suspension, and built the motor into all wheel rings, and TRC corresponding to it or ABS control can be performed, a slip etc. can be lessened and transit stability can be raised. moreover , since the non-slip ring ordered the left-hand side and right-hand side of a car body at a time at least one output torque value to each motor at a certain time after adjust so that the direction moment of a yaw new into a car body might not act , 8WD(s) can be realize prevent generating of the direction moment of a yaw , and transit stability control with the high dependability at the time of a slip can be realize .

[0103] (3) Since the fail-safe device was included in the electronic control system, car control can be carried out to stability. That is, have the wheel system supported in a tandem wheel mounted suspension, and it sets to each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which built the motor into all wheel rings. Since the control which can improve transit stability was adopted, when a slip etc. can be lessened, and transit stability can be raised and one piece does not have a non-slipping ring in the left-hand side of a car body, either, and when one piece cannot be found in right-hand side, either Since it was ordered output torque value to each motor after adjusting according to the slip condition of a slip ring, Since it can realize and TRC/ABS equivalent control operates TRC/ABS equivalent control without the member for the pressure operated of the fluid for braking under a suitable situation, the transit stability control with the high dependability at the time of a slip is realizable.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the system configuration Fig. of the electric vehicle in which the example of this invention is shown.
[Drawing 2] It is the block diagram of the electronic control system of the electric vehicle in which the example of this invention is shown.
[Drawing 3] It is the flow chart which shows the car-body-speed detection step which shows the example of this invention.
[Drawing 4] It is the flow chart which shows the target yaw rate (whenever [angle-of-slide]) adaptation control step which shows the example of this invention.
[Drawing 5] It is the flow chart which shows the TRC/ABS control step which shows the example of this invention.
[Drawing 6] It is the flow chart which shows the operations sequence of the car control section which shows the example of this invention.
[Drawing 7] It is drawing showing the basic configuration of an electric power automobile.
[Description of Notations]
1 Car Control Section (CPU)
2, 3, 4, 5 Motor control section (CPU)
6 Dc-battery
9 Power Sensor
10, 10', 11, 11', 12, 12', 13, 13' Inverter
14 Brake Sensor
15 Rudder Angle Sensor
16 Shift Position Switch

17 Accelerator Sensor
18 Temperature Sensor
19 Abnormality Detection Sensor
20 Brake Pedal
21 Master Cylinder
A Cell control section
B Charge control section
C Brake control section
22 Steering Control Section
30, 31, 32, 33, 34, 35, 36, 37 Motor
40 Forward Right Section Front Wheel RFF
41 Forward Right Section Rear Wheel RFR
42 Forward Left Section Front Wheel LFF
43 Forward Left Section Rear Wheel LFR
44 Right Rear Section Front Wheel RRF
45 Right Rear Section Rear Wheel RRR
46 Left Rear Section Front Wheel LRF
47 Left Rear Section Rear Wheel LRR
50, 51, 52, 53, 54, 55, 56, 57 Rotation position sensor
60, 61, 62, 63, 64, 65, 66, 67 Brake wheel
70, 71, 72, 73 Rotation position sensor (RPS)
VRFF, VRFR, VLFF, VLFR, VRRF, VRRR, VLRF, VLRR Wheel speed
PRFR, PRFF, PLFF, PLFR, PRRF, PRRR, PLRR, PLRF Rotation location
TRF, TLF, TRR, TLR Torque command
CR Detour trunk transmission line for control signals
CR2, CR3, CR4, CR5, CR10, CR11, CR12, CR13 detour transmission line
R1, R2, R3, R4, R5, R10, R11, R12, R13 Transmission line
N1, N2, N3, N4, N5, N10, N11, N12, N13 Node
N1a, N2a, N3a, N4a, N5a, N10a, N11a, N12a, N13a Processing means
N1b, N2b, N3b, N4b, N5b, N10b, N11b, N12b, N13b Self-node ID storage means
N1c, N2c, N3c, N4c, N5c, N10c, N11c, N12c, N13c Adjacent node ID storage means

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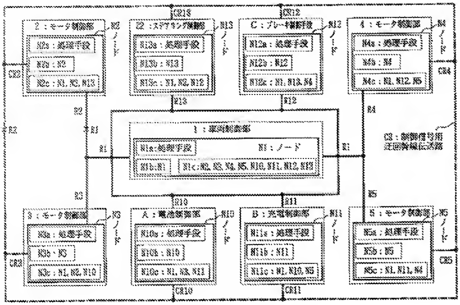
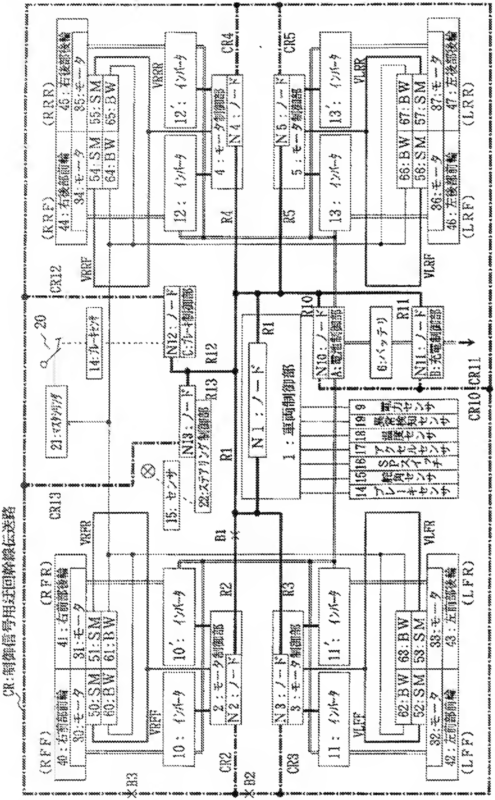
[Translation done.]

DRAWINGS

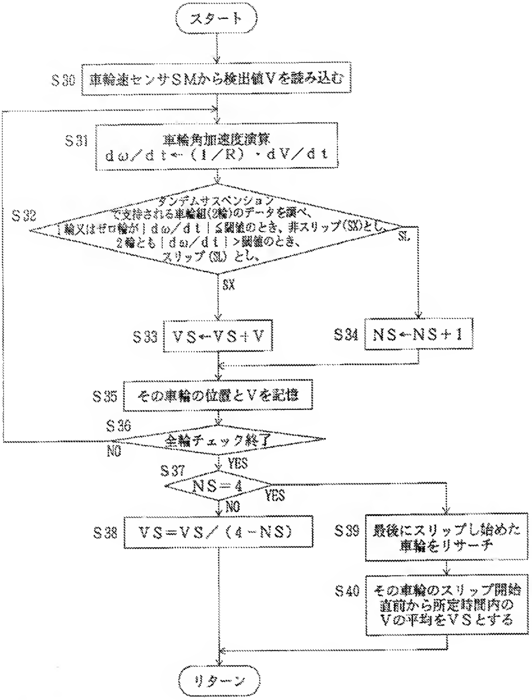
[Drawing 2]


CR13
CR12
2：モータ制御部
C：ブレーキ制御手段
4：モータ制御部
N12a：処理手段
N12b：N12
N4c：N1, N12, N5
N1：ノード
N1a:処理手段
N1c：N2, N3, N4, N5, N10, N11, N12, N13
3：モータ制御部
A：電池制御部
B：充電制御部
5：モータ制御部
N10a：処理手段
N11a：処理手段
N5a：処理手段
N11c：N1, N10, N5
N5c：N1, N11, N4
CR10
CR11
CR5

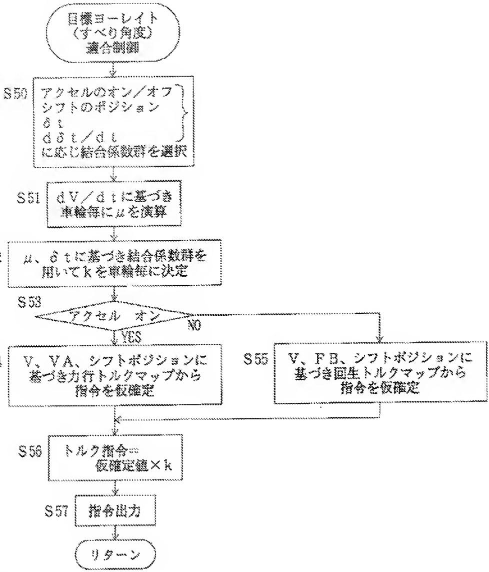
[Drawing 1]


1：車両制御部
N1：ノード
6:バッテリ
CR2
CR3
CR4
CR5
CR10
CR11
CR12
CR13
R1
B1
B2
B3
(RFF)
(RFR)
(RRF)
(RRR)
(LFF)
(LFR)
(LRF)
(LRR)

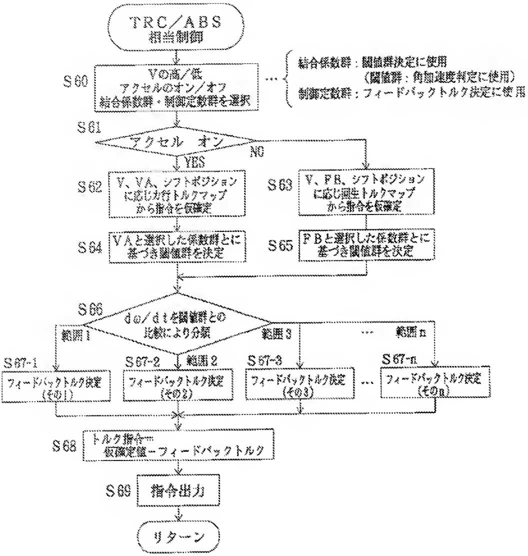
[Drawing 3]


スタート
S30
車輪速センサSMから検出値Vを読み込む
S31
車輪角加速度演算
dω／dt←（1／R）・dV／dt
S32
タンデムサスペンションで支持される車輪組(2輪)のデータを調べ、
1輪又はゼロ輪が｜dω／dt｜≦閾値のとき、非スリップ(SX)とし、
2輪とも｜dω／dt｜＞閾値のとき、スリップ(SL)とし、
SL
SX
S33
VS←VS＋V
S34
NS←NS＋1
S35
その車輪の位置とVを記憶
S36
全輪チェック終了
NO
YES
S37
NS＝4
YES
NO
S38
VS＝VS／（4－NS）
S39
最後にスリップし始めた車輪をリサーチ
S40
その車輪のスリップ開始直前から所定時間内のVの平均をVSとする
リターン

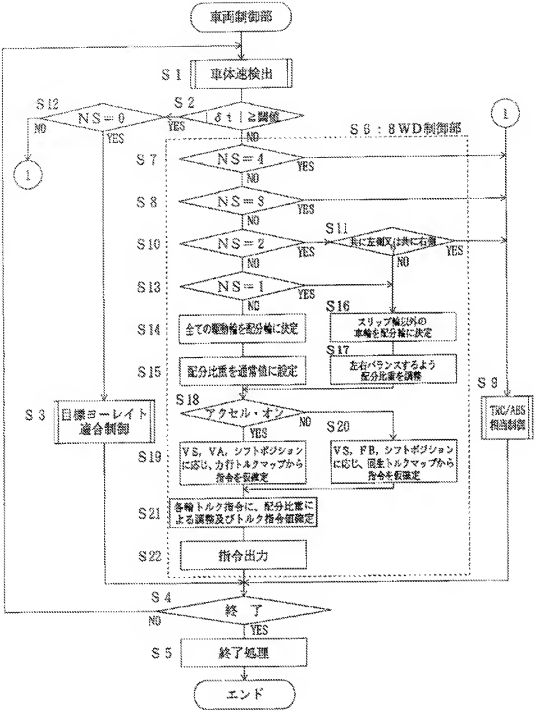
[Drawing 4]


目標ヨーレイト
（すべり角度）
適合制御
S50
アクセルのオン／オフ
シフトのポジション
δｔ
ｄδｔ／ｄｔ
に応じ結合係数群を選択
S51
ｄＶ／ｄｔに基づき
車輪毎にμを演算
S52
μ、δｔに基づき結合係数群を
用いてｋを車輪毎に決定
S53
アクセル　オン
NO
YES
S54
Ｖ、ＶＡ、シフトポジションに
基づき力行トルクマップから
指令を仮確定
S55
Ｖ、ＦＢ、シフトポジションに
基づき回生トルクマップから
指令を仮確定
S56
トルク指令＝
仮確定値×ｋ
S57
指令出力
リターン

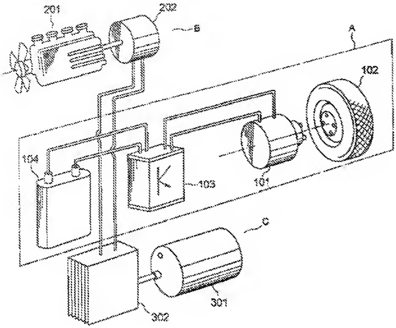
[Drawing 5]


TRC／ABS
相当制御
S60
Vの高／低
アクセルのオン／オフ
結合係数群・制御定数群を選択
結合係数群：閾値群決定に使用
（閾値群：角加速度判定に使用）
制御定数群：フィードバックトルク決定に使用
S61
アクセル　オン
YES
NO
S62
V、VA、シフトポジション
に応じ力行トルクマップ
から指令を仮確定
S63
V、FB、シフトポジション
に応じ回生トルクマップ
から指令を仮確定
S64
VAと選択した係数群とに
基づき閾値群を決定
S65
FBと選択した係数群とに
基づき閾値群を決定
S66
dω／dtを閾値群との
比較により分類
範囲1
範囲2
範囲3
範囲n
S67-1
フィードバックトルク決定
（その1）
S67-2
フィードバックトルク決定
（その2）
S67-3
フィードバックトルク決定
（その3）
S67-n
フィードバックトルク決定
（そのn）
S68
トルク指令＝
仮確定値－フィードバックトルク
S69
指令出力
リターン

[Drawing 6]


車両制御部
S 1
車体速検出
S 2
|δt|≧閾値
S 12
NS＝0
NO
YES
YES
NO
S 6：8WD制御部
S 7
NS＝4
S 8
NS＝3
S 10
NS＝2
S 11
共に左側又は共に右側
S 13
NS＝1
S 14
全ての駆動輪を配分輪に決定
S 16
スリップ輪以外の車輪を配分輪に決定
S 15
配分比重を通常値に設定
S 17
左右バランスするよう配分比重を調整
S 9
TRC/ABS相当制御
S 3
目標ヨーレイト適合制御
S 18
アクセル・オン
S 19
VS，VA，シフトポジションに応じ、力行トルクマップから指令を仮確定
S 20
VS，FB，シフトポジションに応じ、回生トルクマップから指令を仮確定
S 21
各輪トルク指令に、配分比重による調整及びトルク指令値確定
S 22
指令出力
S 4
終了
S 5
終了処理
エンド

[Drawing 7]



[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

WRITTEN AMENDMENT

-- [a procedure revision]
[Filing Date] October 19, Heisei 13 (2001. 10.19)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Whole sentence
[Method of Amendment] Modification
[Proposed Amendment]
[Document Name] Specification
[Title of the Invention] The control unit of an electric vehicle
[Claim(s)]
[Claim 1] In the electric vehicle with which two or more driving wheels are in one vehicle, and the motor for a drive per piece is attached in each of this driving wheel,
The control unit of the electric vehicle characterized by providing the main control unit which has the function to receive the situation of delivery, said motor for a drive, and said speed regulating device of

operation for the control signal for acceleration and deceleration as a signal for control based on the command from an operator or a mounted sensor to each of this speed regulating device while the speed regulating device for making the electrical signal from the outside perform acceleration and moderation to each of said motor for a drive is attached.

[Claim 2] The control unit of the electric vehicle characterized by containing each of the electrical potential difference of a cell, the current supplied from this cell, and cell temperature as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.

[Claim 3] The control unit of the electric vehicle characterized by including the steering angle of a steering as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.

[Claim 4] The control unit of the electric vehicle characterized by including the sensor signal which shows that it is under charge from charging equipment as a sensor signal inputted into said main control unit in the control unit of an electric vehicle according to claim 1.

[Claim 5] The control device of the electric vehicle characterized by including the sensor signal which shows the brake command value from a brake control section, and the oil pressure of a master cylinder as a sensor signal inputted into said main control unit in the control device of an electric vehicle according to claim 1.

[Claim 6] The control unit of the electric vehicle characterized by including the steering angle signal of a steering in the control unit of an electric vehicle according to claim 1 as a control signal sent from said main control unit.

[Claim 7] The control unit of the electric vehicle characterized by having the fail-safe means of the signal-transmission way which the retrieval message which the node which detected the communication failure in the electronic control system of a car searches for a transmission route is transmitted, and the node which can form a transmission line returns a response message, and forms a detour.

[Claim 8] It is the control unit of the electric vehicle characterized by consisting of a self-node ID storage means by which said node memorizes the identifier of a self-node in the control unit of an electric vehicle according to claim 7, an adjacent node ID storage means to memorize the identifier of the adjacent node connected to said transmission line, and a processing means to process routing based on the message sent to said node.

[Claim 9] It is the control unit of the electric vehicle characterized by being prepared in the motor control section which prepared said node for every car control section and wheel group in the control unit of an electric vehicle according to claim 8.

[Claim 10] It is the control device of the electric vehicle characterized by preparing said node in the cell control section, the steering control section, the brake control section, and the charge control section in the control device of an electric vehicle according to claim 8.

[Claim 11] The motor control section prepared for every said car control section and wheel group in the control unit of an electric vehicle according to claim 9 is the control unit of the electric vehicle characterized by controlling a power converter by the control signal inputted through the node prepared in each.

[Claim 12] The control unit of the electric vehicle characterized by constituting said detour from a detour trunk transmission line for control signals which constitutes a closed loop, and a detour transmission line between this detour trunk transmission line and said each motor control section in the control unit of an electric vehicle according to claim 9 or 10.

[Claim 13] It is the control unit of the electric vehicle characterized by suspending actuation of said motor control section, detecting that said car control section does not have the response from said specific node, and separating the motor control section of said specific node from a control-section object when it detects that the failure generated the specific node in all the transmission lines between said car control sections, and detour transmission lines in the control unit of an electric vehicle according to claim 12.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the control unit of the electric vehicle which equipped the electronic control system of a car with the fail-safe means.
[0002]
[Description of the Prior Art] Development of a perfect electric vehicle is becoming pressing need as one conclusive factor of preventing the air pollution by motorization. Recognizing that maintenance of natural environment will be the big target in the 21st century, the artificer of this application will start from the 1980 time at the research, and is getting the result.
[0003] As shown in drawing 7 , only using the driving force of a motor 101, an electric vehicle is a vehicle it can run and is made to call the thing [thing / thing / using a rechargeable battery (dc-battery) as a power source supplied to the motor 101 / using an electric vehicle A and an engine generator in a narrow sense] using the series hybrid vehicle B and a fuel cell the fuel cell vehicle C. 102 -- for a rechargeable battery and 201, as for a generator and 301, an engine and 202 are [a wheel and 103 / a controller and 104 / a hydrogen source of supply and 302] fuel cells.
[0004] Thus, an electric vehicle is defined as the vehicle which used things which combined these, such as a generator, a solar battery, etc. using the rechargeable battery, the fuel cell, and the internal combustion engine as a power source which is the vehicle it can run and is supplied to the electric motor, only using the driving force of a rotating type electrical-and-electric-equipment motor. However, although the electric vehicle which used only the rechargeable battery is borne in mind in the following explanation, naturally the vehicle which makes a power source a fuel cell, an internal combustion engine generator, and a solar battery is also included.
[0005] In order to raise the safety and facility of operation of a car, a component with the gradually redundant electronic system which poses an insurance top problem of a car, for example, a sensor, and a computer element are carried increasingly.
[0006] For example, the example in which a position sensor or a rotational frequency sensor of an operational operating member etc. is formed in redundancy by the operator is introduced. The signal of the measuring device constituted by this redundancy is supplied to two processors which control the drive output of a car based on the respectively almost same computer program. The output signal of both processors acts on the same good variate which affects the output of the drive unit of a car in that case.
[0007] However, if this kind of system is completely made into redundancy, it will become remarkably complicated, and by it, cost will increase and the frequency of failure will also increase.
[0008] Two or more electronic control units are carried in the current car as known. A speed-control unit, a steering control unit, etc. are mentioned especially. These control units act on other good variates of the drive unit of a car, respectively.
[0009] In a current car, an electronic connection system connects mutually and these control units exchange data and information mutually through it.
[0010] Although the method of passing the electric signal from an accelerator pedal is used for the control unit which controls the current passed to a motor, especially speed control of an electric vehicle is the case where two or more motors are used for a drive, and when controlling acceleration of a vehicle, moderation, and turn combination, it needs one more central control unit which controls the whole vehicle. Until now, in such a control unit, between a central control unit and the control units attached in each motor was connected with the signal line, respectively, and control was performed.
[0011]
[Problem(s) to be Solved by the Invention] However, by the approach of such control, when un-arranging arises in each communication wire, it becomes impossible to control each motor.
[0012] This invention makes a signal transmission possible also between the control units attached in each motor in view of the above-mentioned situation, and aims at offering the control unit of the electric vehicle which detours when un-arranging arises in one of the transmission lines, and can transmit and receive control information.
[0013]
[Means for Solving the Problem] In order that the invention in this application may attain the above-mentioned purpose,

[1] In the electric vehicle with which two or more driving wheels are in one vehicle, and the motor for a drive per piece is attached in each of this driving wheel While the speed regulating device for making the electrical signal from the outside perform acceleration and moderation to each of said motor for a drive is attached It is characterized by providing the main control unit which has the function to receive the situation of delivery, said motor for a drive, and said speed regulating device of operation for the control signal for acceleration and deceleration as a signal for control based on the command from an operator or a mounted sensor to each of this speed regulating device.
[0014] [2] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by containing each of the electrical potential difference of a cell, the current supplied from this cell, and cell temperature as a sensor signal inputted into said main control unit.
[0015] [3] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the steering angle of a steering as a sensor signal inputted into said main control unit.
[0016] [4] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the sensor signal which shows that it is under charge from charging equipment as a sensor signal inputted into said main control unit.
[0017] [5] In the control device of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the sensor signal which shows the brake command value from a brake control section, and the oil pressure of a master cylinder as a sensor signal inputted into said main control unit.
[0018] [6] In the control unit of the electric vehicle of the above-mentioned [1] publication, it is characterized by including the steering angle signal of a steering as a control signal sent from said main control unit.
[0019] [7] It is characterized by having the fail-safe means of the signal-transmission way which the retrieval message which the node which detected the communication failure in the electronic control system of a car searches for a transmission route is transmitted, and the node which can form a transmission line returns a response message, and forms a detour.
[0020] [8] In the control unit of the electric vehicle of the above-mentioned [7] publication, said node is characterized by consisting of a self-node ID storage means to memorize the identifier of a self-node, an adjacent node ID storage means to memorize the identifier of the adjacent node connected to said transmission line, and a processing means to process routing based on the message sent to said node.
[0021] [9] In the control unit of the electric vehicle of the above-mentioned [8] publication, said node is characterized by being prepared in the motor control section prepared for every car control section and wheel group.
[0022] [10] In the control device of the electric vehicle of the above-mentioned [8] publication, said node is characterized by being prepared in the cell control section, the steering control section, the brake control section, and the charge control section.
[0023] [11] In the control unit of the electric vehicle of the above-mentioned [9] publication, the motor control section prepared for every said car control section and wheel group is characterized by controlling a power converter by the control signal inputted through the node prepared in each.
[0024] [12] In the control unit of an electric vehicle the above [9] or given in [10], it is characterized by constituting said detour from a detour trunk transmission line for control signals which constitutes a closed loop, and a detour transmission line between this detour trunk transmission line and said each motor control section.
[0025] [13] In the control unit of the electric vehicle of the above-mentioned [12] publication, when it detects that the failure generated the specific node in all the transmission lines between said car control sections, and detour transmission lines, actuation of said motor control section is suspended, and it detects that said car control section does not have the response from said specific node, and is characterized by separating the motor control section of said specific node from a control-section object.

[0026]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained,

referring to a drawing. Here, it has the wheel system used as the example of representation by which two flowers are supported each in a tandem wheel mounted suspension, has the driving wheel of six or more flowers, and is carried in the electric vehicle which considered each driving wheel as the Inn wheel mounted drive, and the embodiment which applies a fail-safe device to the control unit which carries out the motor control of each so that the transit stability at the time of a slip may be raised is explained.
[0027] The description of this invention is in the fail-safe means in a control system equipped with an electronic control unit, and the control system and equipment of the complementary become suitably applicable.
(1) System configuration
Drawing 1 is the system configuration Fig. of the electric vehicle in which the example of this invention is shown.
[0028] It is not necessary to be the wheel system by which order both wheels were supported in the tandem wheel mounted suspension, and you may be the wheel system by which only the wheel system of before or the back was supported in the tandem wheel mounted suspension in this invention.
[0029] The electric vehicle in this embodiment is an eight-flower drive electric vehicle of an in wheel motor mold. That is, it is each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which has the wheel system supported in a tandem wheel mounted suspension, and built the motor into all wheel rings.
[0030] Thus, by constituting, the support load for every wheel can be lessened, TRC corresponding to it or ABS control can be performed, a slip etc. can be lessened, and transit stability can be raised.
[0031] When the transducer which can drive according to various kinds of power sources, such as an alternating current, a direct current, and a pulse, and corresponds according to the class of the power source, for example, a power source, is an alternating current, a transducer is an inverter, each motor is a converter when it is a direct current, and when it is a pulse, it is a chopper etc.
[0032] An alternating current explains an embodiment in case a transducer is the following and a power source is an inverter.
[0033] The car control section 1 is equipped with a microcomputer, inputs the detection information from various sensors, performs required processing, and outputs a control command to each motor control sections (CPU) 2, 3, 4, and 5. Said control command from the car control section (CPU) 1 minds transmission lines R1, R2, R3, R4, R5, R10, R11, R12, and R13, the detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13, and the detour trunk transmission line CR for control signals. It is outputted to each motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22.
[0034] Moreover, the car control section 1 consists of control of the output torque of each motors 30, 31, 32, 33, 34, 35, 36, and 37, revolving speed control, speed control, house keeping and control of mounted each component, the information of the car condition to car crew, electric supply control of a dc-battery, charge control of a dc-battery, brake control, steering control, and an electronic control unit (ECU) that bears other functions, and has a micro program for processing for performing said function. furthermore, to the car control section 1 A rotation position sensor (SM) the power sensor 9 for 50, 51, 52, 53, 54, 55, 56 and 57, and the electrical-potential-difference value and current value detection of a dc-battery, the brake sensor 14 which detects actuation of a brake, the rudder angle sensor 15 which detects the steering angle of a handle, and the shift position of a shift lever The detection output of the abnormality detection sensor 19 which detects that the temperature sensor 18, and the electrical-potential-difference value and current value of a converter which detect the shift position (SP) switch 16 to detect, the accelerator sensor 17 which detects the opening of an accelerator, dc-battery temperature, converter temperature, etc. fell from the threshold etc. is inputted.
[0035] The rotation position sensors (for example, resolver) 50, 51, 52, 53, 54, 55, 56, and 57 prepared for every wheel generate the signal (for example, the minute angular position pulse signal for every variation rate) which shows the wheel speed VRFF, VRFR, and VLFF, VLFR, VRRF, VRRR, VLRF, and VLRR of each wheel, and supply it to the car control section 1.
[0036] The accelerator sensor 17 makes the signal with which a shift position switch 16 shows the signal

with which the brake sensor 14 shows the amount of treading in of a brake pedal 20 for the signal which shows the amount of treading in of an accelerator pedal (not shown), the injection range (the engine brake range shift-lever location [And] within the range concerned), i.e., the shift position, of a shift lever (not shown), output, respectively. The rudder angle sensor 15 makes the signal which shows signal, for example, rudder angle, deltat which shows the result of rudder angle detection of a handle output. The power sensor 9 of a dc-battery 6 measures and outputs the electrical-potential-difference value and current value of a dc-battery 6. A temperature sensor 18 measures and outputs the temperature of devices, such as an inverter. The abnormality detection sensor 19 outputs an abnormality signal, when the electrical-potential-difference value and current value of an inverter turn into below a threshold.

[0037] In inputting into the car control section 1, each output of these sensors is changed into the data of a format which can be processed by the car control section 1. The car control section 1 performs the decision of a torque command, a rotational frequency command, a rate command, etc., a switch of the control approach, etc. using the data after conversion. Hereafter, the embodiment of a torque control is explained as instantiation.

[0038] Each motor control sections 2, 3, 4, and 5 are equipped with a microcomputer, input the control command from the car control section 1 through a transmission line, carry out required processing, and they are constituted so that a control command may be outputted to inverter 10, 10', 11, 11', 12, 12', 13, and 13'. According to the torque command TRF, the motor control section 3 controls inverter [with which the motor control section 5 corresponds according to the torque command TLR according to the torque command TRR respectively according to the torque command TLF in the motor control section 4] 10, 10', 11, 11', 12, 12', 13, and 13', and the motor control section 2 carries out the torque control of the motors 30, 31, 32, 33, 34, 35, 36, and 37. All torque commands given to the motor control sections 2, 3, 4, and 5 are outputted from the car control section 1. Control of inverter 10 and 10', 11, 11', 12, 12', 13, and 13' is performed based on each phase current estimate of the motor for which it asked from the Rota angular position etc. based on each phase current detection value of the motor obtained from the current sensor which is not illustrated. [to each motors 30, 31, 32 33, 34, 35 36, and 37]

[0039] As for the wheel system supported in a tandem wheel mounted suspension, motors 30, 31, 32, 33, 34, 35, 36, and 37 are built into the forward right section front wheel RFF40, the forward right section rear wheel RFR41, the forward left section front wheel LFF42, the forward left section rear wheel LFR43, the right rear section front wheel RRF44, the right rear section rear wheel RRR45, the left rear section front wheel LRF46, and the left rear section rear wheel LRR47, respectively.

[0040] A dc-battery 6 is a drive power source of supply to each motor, and electric power is supplied to the output by motors 30 and 31 on motors 36 and 37 through motors 34 and 35 and an inverter 13, and 13' at motors 32 and 33 through an inverter 12 and 12' through an inverter 11 and 11', respectively through an inverter 10 and 10'. In order to output a dc-battery 6 to the basis of control of the motor control section 2 controlled by the car control section 1 and to output a torque control, speed control, etc. on motors 30 and 31, the power of an inverter 10 and 10' is converted (it changes into the three-phase alternating current in this drawing), and they supply electric power. Inverter 11, 11', 12, 12', 13, and 13' operates similarly.

[0041] In drawing 1 , the braking system which brakes tandem-type front and rear, right and left each ring by both oil pressure and regeneration is used by the design plan which secures safety.

[0042] That is, if a brake pedal 20 is stepped on, the oil pressure generated in the master cylinder 21 according to this will act on the brake wheels BW60, BW61, BW62, BW63, BW64, BW65, BW66, and BW67 through the wheel cylinder prepared in each wheel, and damping torque will be given to a wheel.

[0043] It is inputted into the car control section 1 by the transmission line R12 where the detecting signal according to the brake force (oil pressure of a master cylinder 21) FB detected using the brake sensor 14 minded the node N12 on the other hand, and the car control section 1 generates the torque commands TRF, TLF, TRR, and TLR which start regeneration based on said detecting signal. A regeneration command turns into the command according to a control command, for example, a torque command, a rate command, etc.

[0044] Therefore, the braking force distribution in the car of drawing 1 turns into allocation to which

both oil pressure regeneration increases with increase of a brake force FB. Thus, since a hydraulic system and a regeneration network dissociate after the brake sensor 14 and are further backed up by the transmission line, even if oil pressure and either of the regeneration malfunction, a car can be evacuated on the other hand.

[0045] Furthermore, since it is [that the hydraulic pump for TRC/ABS control is not formed in a hydraulic system, but the proportioning valve for rationalizing allocation before and after oil pressure damping force is only prepared, and], the oil pressure braking structure of a system becomes simple. In addition, one of the reasons which does not need to form the hydraulic power unit for TRC/ABS in a hydraulic system is in the characteristic configuration of this operation gestalt of performing transit stability control using control of the output torque of motor 12FR, 12floor line, 12RR, and 12RL(s), like the after-mentioned.

[0046] The detour trunk transmission line CR for control signals where the failsafe device used as the description of this invention constitutes a closed loop Each motor control sections 2, 3, 4, and 5 from this detour trunk transmission line CR, the cell control section A The detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13 connected to the charge control section B, the brake control section C, and the steering control section 22, Each motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22, It consists of transmission lines which connect the car control section 1 which controls the whole, and each of this motor control section, the cell control section A, the charge control section B, the brake control section C, the steering control section 22 and the car control section 1.

(2) Fundamental control of a car

Drawing 6 is a flow chart which shows the operations sequence of the car control section which shows the example of this invention.

[0047] The car control section 1 performs detection of car body speed VS first (step S1).

[0048] Although various procedures as a detection procedure of car body speed VS are employable, it is desirable to, adopt a procedure as shown in drawing 3 for example. Hereafter, the flow chart of drawing 3 shows the procedure of detecting car body speed VS. In this drawing, the car control section 1 reads the detection value V of the wheel speed sensor SM every two flowers as one set which has tandem construction first (step S30), and calculates that wheel angular-acceleration d omega/dt (step 31). As operation expression of wheel angular acceleration, it is the following formula.

d omega/dt <- (1/R) -dV/dt

******** -- things are made. R is a wheel radius among an upper type, and V and omega are the wheel speed and wheel angular velocity concerning the wheel which is going to ask for current wheel angular acceleration.

[0049] The absolute value of wheel angular-acceleration d omega/dt for which carried out in this way and it asked has exceeded the predetermined threshold, or the car control section 1 compares about the above-mentioned one set. When the absolute value of wheel angular-acceleration d omega/dt has exceeded both of thresholds among one set (all rings), it judges with a slip (SL). Although one of one sets has exceeded the threshold, when one more flower does not exceed a threshold The wheel speed V of the direction which does not exceed a threshold while judging un-slipping (SX) is held as wheel speed of the set. When the wheel angular acceleration of domega / absolute value of dt does not exceed both of thresholds among one set (all rings), while judging with un-slipping (SX), the wheel speed of a large value is held as wheel speed of the set (step S32).

[0050] When the one-set wheel is judged with un-slipping (SX), the wheel speed V of the wheel is integrated to Variable VS (step S33). On the contrary, since it can consider that a slip or its inclination has occurred about the wheel if the absolute value of angular-acceleration d omega/dt has exceeded the predetermined threshold when the one-set wheel is judged with a slip, one increment of NS(s) which are a variable for counting the number of the wheel (slip ring) which can be regarded as a slip or its inclination having arisen is carried out (step S34).

[0051] After the car control section 1 performs step S33 or S34, it is memorized in the memory which builds in the location and wheel speed V of the one-set wheel (step S35). The car control section 1

performs the procedure concerning steps S31-S35 about all the driving wheels containing the wheel of all tandem construction (step S36).

[0052] After it carries out the car control section 1 in this way and it performs the judgment of a slip ring, or an it and a non-slipping ring about all driving wheels, it judges whether is so in whether any whether the number NS of a slip ring being equal to 4 and driving wheels have slipped (step S37). usually, the value with which the car control section 1 was integrated by VS by repeat activation of step S33 in order that, as for an example, all driving wheels might not make a slip or its inclination coincidence -- the number of 4-NS, i.e., a non-slipping ring, -- **** -- car body speed VS is computed by things (step S38).

[0053] On the contrary, when NS=4 are materialized, it searchs which wheel the driving wheel which began to slip at the end is using the information memorized when step S35 was performed in the past (step S39).

[0054] The car control section 1 presupposes that the value of the wheel speed V which it had just before the wheel which began to slip, the driving wheel, i.e., last, discovered as a result of this search, begins to have slipped is used as car body speed VS (step S40).

[0055] Thus, in this operation gestalt, the torque command value by which temporary decision is carried out is made suitable in the procedure which makes it possible to determine car body speed VS comparatively correctly, as a result is mentioned later by asking for car body speed VS only from the wheel speed of a non-slipping ring in principle. moreover, since it is tandem suspension structure, it will be called a very rare condition that all eight wheels show a slip or its inclination, but since it is considering as car body speed VS also then with the average of the wheel speed which it had in a predetermined within a time one from from just before the wheel which began to slip at the end begins to slip, the car body speed information which can set dependability comparatively can use for temporary decision of a torque command value. After step S38 or S40 activation, actuation of the car control section 1 returns to step S2 of drawing 6 .

[0056] In drawing 6 , after detecting car body speed VS, in order to judge the condition of steering first, the absolute value of rudder angle deltat is the same as a predetermined threshold, or that judgment is performed more than it (step S2). By the case where a rudder angle is larger than a threshold, when there is no slip (step S12), the car control section 1 performs adaptation control (for example, whenever [angle-of-slide] 0 control) whenever [target yaw REITO adaptation control or target angle-of-slide] (step S3).

[0057] For example, when the absolute value of rudder angle deltat detected by the rudder angle sensor 15 is beyond a predetermined threshold (i.e., when it is judged that the car pilot is steering), adaptation control is performed [that generating of the transit instability of the car body accompanying steering should be prevented thru/or controlled] whenever [target yaw REITO adaptation control thru/or target angle-of-slide].

[0058] An example of the procedure of adaptation control is shown in drawing 4 whenever [target yaw REITO adaptation control thru/or target angle-of-slide].

[0059] In the flow shown in drawing 4 , the car control section 1 has chosen the coupling-coefficient group (formula based on experience) based on ddeltat/dt computable based on rudder angle deltat and this which are given from the accelerator-on / OFF state which can be first judged based on the output of the accelerator sensor 17, the shift position given by the shift position switch 16, and the rudder angle sensor 15 etc. (step S50).

[0060] The car control section 1 calculates the road surface coefficient of friction mu (formula based on experience) further based on this in quest of wheel acceleration dv/dt for every wheel of tandem suspension structure (step S51). The car control section 1 determines a correction factor k for every wheel using the coupling-coefficient group chosen at step S50 based on the road surface coefficient of friction mu and rudder angle deltat (step S52).

[0061] The car control section 1 carries out temporary decision of the torque command for every wheel from a power running torque map based on (step S53), wheel speed V, the accelerator opening VA, and a shift position, when the accelerator turns on (step S54). Moreover, when the accelerator turns off,

based on (step S53), wheel speed V, a brake force FB, and a shift position, temporary decision of the torque command is carried out for every wheel from a regeneration torque map (step S55). A rotational frequency and torque are the maps showing the rotational frequency torque characteristic of the motor in a forward field, both power running torque maps are maps which forward and torque show the rotational frequency torque characteristic of the motor in a negative field, and the rotational frequency asks them for the regeneration torque map by experience.

[0062] By multiplying by the correction factor determined as the torque command which carried out temporary decision at step S52 in step S54 or S55, the car control section 1 opts for a torque command (step S56), and outputs the determined torque command to the corresponding motor control section (step S57).

[0063] Therefore, according to the setting technique of the value of the coupling-coefficient group which serves as a candidate for selection at step S50, and the correction factor k in step S52, the range which a torque command when performing adaptation control whenever [target yaw REITO adaptation control thru/or target angle-of-slide] can take may serve as the value which may turn into a value belonging to the time of accelerator-on, or a regeneration field, and belongs to a power-running field also in the time of accelerator-off. By performing such control, the transit stability of the car body at the time of steering is raised with this operation gestalt.

[0064] In addition, please refer to the indication of JP,10-210604,A about adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide]. Moreover, it may replace with adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide], and the technique of performing transit stability control using two or more quantity of states which show the movement conditions of a car including yaw REITO which acts on a car body may be adopted.

[0065] Please refer to JP,10-271613,A about this technique. After ending adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide], actuation of the car control section 1 returns to drawing 6 .

[0066] The car control section 1 repeats return actuation to step S1. Moreover, in step S2 performed after detecting car body speed VS, when the absolute value of a rudder angle is smaller than a threshold when it is admited that it is not necessary to perform adaptation control whenever [target yaw REITO adaptation control or target angle-of-slide] namely, the car control section 1 performs the procedure which starts 8WD control in principle (step S6).

[0067] The car control section 1 is faced starting this 8WD control step S6, and performs judgment / classification processing about the number NS of the slip ring corresponding to one set of wheels in the tandem suspension structure first detected in the procedure of detecting car body speed VS.

[0068] Namely, the time (step S7) of all driving wheels showing a slip or its inclination, when the number NS of the detected slip ring is equal to 4, When the number NS of a slip ring is equal to 3 (step S8) (i.e., when there is only one driving wheel (one set) of the tandem suspension structure which does not show a slip or its inclination) Actuation of the car control section 1 shifts to the TRC/ABS equivalent control instead of 8WD control (step S6) (step S9).

[0069] Moreover, even if it is a time (step S10) of two driving wheels of the tandem suspension structure which does not show a slip or its inclination existing when the number NS of a slip ring is equal to 2 namely, when [both] both the detected slip rings are left-hand side wheels, in being a right-hand side wheel (step S11), it shifts to TRC/ABS equivalent control (step S9).

[0070] furthermore -- even if it is a time of being judged with it being in the condition that adaptation control is regarded as the need in the above-mentioned step S2 whenever [target yaw REITO adaptation control thru/or target angle-of-slide] -- the number NS of a slip ring -- un--- the time of it being admited that the driving wheel of one of tandem suspension structures shows a slip or its inclination when it is 0 -- (step S12) -- it shifts to TRC/ABS equivalent control too (step S9).

[0071] An example of the procedure of TRC/ABS equivalent control is shown in drawing 5 .

[0072] Facing performing TRC/ABS equivalent control, the car control section 1 chooses a coupling-coefficient group, a controlled parameter group, etc. first according to the height of the wheel speed V of each wheel, accelerator-on / OFF, etc. (step S60).

[0073] It is the set of the multiplier used in order that a coupling-coefficient group here may determine the threshold group used for the below-mentioned angular-acceleration judging, and a controlled parameter group is the set of the constant used in case feedback torque is determined. In step S61, the car control section 1 carries out temporary decision of (step S63) and the torque command from a regeneration torque map according to wheel speed V, a brake force FB, and a shift position. when the accelerator turns on and (step S62) and an accelerator turn off from the power running torque map according to wheel speed V, the accelerator opening VA, and a shift position.
[0074] Further, the car control section 38 determines a threshold group based on the coupling-coefficient group chosen at the accelerator opening VA and step S60, when the accelerator turns on in step S61 (step S64). Moreover, when the accelerator turns off, a threshold group is determined based on a brake force FB and the coupling-coefficient group chosen at step S60 (step S65).
[0075] The car control section 1 classifies angular-acceleration d omega/dt of each wheel on the basis of the threshold group determined in step S64 or S65 (step S66). The car control section 1 determines feedback torque using different operation expression etc. according to the result of a classification. for example, wheel angular-acceleration d omega/dt -- the 1st range -- a group -- then -- coming -- being alike -- the feedback torque decision processing by the 1st operation expression -- (step S67-1) -- the 2nd range -- a group -- then -- coming -- being alike -- the feedback torque decision processing based on the 2nd operation expression -- (step S67-2) -- the 3rd range -- a group -- then -- coming -- being alike -- the feedback torque decision processing by the 3rd operation expression -- (step S67-3) -- the -- n-th range -- a group -- then -- coming -- being alike -- the feedback torque decision processing based on the n-th operation expression -- as -- (step S67- n) feedback torque is determined in the operation expression according to the range in which the angle-of-rotation acceleration of domega / dt belongs for every wheel.
[0076] furthermore, step S67-1 and S -- 67-2, S67-3, and ... let the constant in the operation expression concerning step S67-n be a value concerning the controlled parameter group chosen at step S60. By reducing the feedback torque which carried out in this way and was determined in step S62 or S63 from the torque command value which carried out temporary decision, the car control section 1 decides a torque command value (step S68), and outputs the settled torque command value to the corresponding motor control section (step S69).
[0077] By adopting such a procedure, the torque which acts on each driving wheel can be fluctuated suitably, and the function equivalent to the TRC/ABS control in a native engine car can be realized. In addition, please refer to the indication by JP,8-182119,A and JP,10-210604,A about TRC/ABS equivalent control. After ending the procedure shown in drawing 5 , actuation of the car control section 1 shifts to step S4 shown in drawing 6 .
[0078] When, as for the car control section 1, no shift conditions to adaptation control and shift conditions to TRC/ABS equivalent control are satisfied whenever [target yaw REITO adaptation control thru/or target angle-of-slide], Namely, the absolute value of rudder angle deltat does not turn into beyond a threshold, but the number NS (number of sets) of the slip ring of tandem suspension structure is two or less. And when all two left-hand side wheels or two right-hand side wheels are not a slip ring, the procedure concerning 8WD control (step S6) is performed.
[0079] In that case, the car control section 1 judges first whether the number NS of the above-mentioned slip ring is 1 (step S13). On the usual transit way, since it is NS=0, actuation of the car control section 1 shifts to steps S14 and S15. At step S14, the car control section 1 determines all the driving wheels of tandem suspension structure as an allocation ring. An allocation ring here is a driving wheel which actually distributes a torque output. At step S15, the car control section 1 usually sets the specific gravity of allocation of the torque output to each allocation ring as a value. For example, specific gravity =1 of allocation is set up to all driving wheels. However, the specific gravity of this allocation may be changed according to car loading weight, and is not cared about as predetermined specific gravity which is different between the wheels of order according to the structure of a car body.
[0080] On the contrary, when it judges with it being NS=1 in step S13, or when it is judged with the shift conditions to TRC/ABS equivalent control not being satisfied in step S11. wheels other than a car

control-section 1 slip ring are determined as an allocation ring (step S16).

[0081] Furthermore, when torque is actually outputted, the allocation specific gravity to each car is adjusted so that the moment of the direction of a yaw centering on a car-body center of gravity will not newly act on a car body, namely, so that right and left may balance (step S17).

[0082] For example, allocation specific gravity is set to 0 so that a torque command may not be given, the driving wheel, i.e., the slip ring, which was not chosen as the allocation ring in step S16, and if it has not slipped, the allocation specific gravity equivalent to the torque output which must have been distributed to the slip ring is added to the allocation specific gravity of the non-slipping ring of the side to which a slip ring belongs among left-hand side and right-hand side.

[0083] If the accelerator turns on the car control section 1 and (step S19) and an accelerator turn it off from the power running torque map in step S18 according to car body speed VS, the accelerator opening VA, and a shift position after it performs step S15 or S17, it will carry out temporary decision of the torque command from a regeneration torque map according to car body speed VS, a brake force FB, and a shift position (step S20).

[0084] After the car control section 1 performs step S19 or S20, it is adjusted to the torque command value which carried out temporary decision in step S19 or S20 according to the allocation specific gravity currently beforehand set up thru/or adjusted in step S15 or S17 (carrying out the multiplication for example, of the allocation specific gravity), and, thereby, decides the torque command value over each wheel (step S21).

[0085] The car control section 1 outputs each torque command value decided at step S21 to the motor control section which corresponds, respectively (step S22), and shifts to step S4 after that.

[0086] Therefore, with this operation gestalt, a control state changes according to the slip condition of each wheel of tandem suspension structure. First, if two flowers of tandem suspension structure are made into one unit, when only one of four wheels has slipped (i.e., when it is NS=1), the torque command which must have been carried out with the slip ring concerned if it had not slipped will be outputted in other driving wheels in the same side as this slip ring. Moreover, when the slip ring exists at a time in one right and left while at the time of being NS=2 similarly, a torque command is realized with the non-slipping ring which remains one right and left at a time. Furthermore, it is NS=2, and when each slip ring is in left-hand side (or right-hand side), TRC/ABS equivalent control is performed. Furthermore, when it is NS=3, or when it is NS=4, TRC/ABS equivalent control is performed too. thus , since he be try to switch or change the torque allocation specific gravity to the control mode and each wheel of each motor output by the car control section 1 according to the number and the location of the slip in each wheel or the generating situation of the inclination , especially a slip ring , suitable 8WD control and TRC/ABS equivalent control can realize in the eight flower drive electric vehicle of an in wheel motor mold , and , according to this operation gestalt , the maintenance improvement of the transit stability can carry out .

(3) Failsafe device

Since main electronic control units are connected through the detour trunk transmission line CR for control signals as above-mentioned, also when a failure occurs in a transmission line etc., a control system can be backed up, and control of a passage can usually be performed.

[0087] A signal-transmission system is constituted based on the node (communication device) prepared in the car control section 1 which forms an electronic control unit as shown in drawing 2 , the motor control sections 2, 3, 4, and 5, the cell control section A, the charge control section B, the brake control section C, and the steering control section 22. Self-node ID storage means N1b each node (communication device) remembers the identifiers N1, N2, N3, N4, N5, N10, N11, N12, and N13 of a self-node to be, N2b, N3b, N4b, N5b, N10b, N11b, N12b, and N13b, Adjacent node ID storage means N1c which memorizes the identifier of the adjacent node connected to the transmission line and the detour transmission line, N2c, N3c, N4c, N5c, N10c, N11c, N12c, and N13c, It is based on the message sent to a node. Processing of routing The transmission lines R1, R2, R3, R4, R5, and R10 which connect them with two or more nodes N1, N2, N3, N4, N5, N10, N11, N12, and N13 which had processing means N1a to perform, N2a, N3a, N4a, N5a, N10a, N11a, N12a, and N13a, respectively, The alternate-

route setting method which consists of R11, R12, R13, detour transmission lines CR2, CR3, CR4, CR5, CR10, CR11, CR12, and CR13, and a detour trunk transmission line CR for control signals, bypasses the generated failure part, and sets up a communication path is taken.

[0088] According to the above-mentioned alternate-route setting method, each node by polling between the adjacent nodes through the transmission line and detour transmission line which were connected The node which detected as a failure of the communication link in the transmission line or detour transmission line between both when there was no response from a partner, and detected said communication failure The node which transmitted the self identifier and the identifier of the adjacent node connected to the transmission line where said communication failure was detected as a retrieval message s, and received said retrieval message If neither is in agreement as compared with the identifier memorized by the self-node ID storage means of self, or the adjacent node ID storage means as a result of said comparison, the identifier D of said adjacent node in said retrieval message The node which received said retrieval message relays said retrieval message to other nodes, and on the other hand, if either is in agreement as a result of said comparison, the node which received said retrieval message will be returned to the node which detected said communication failure for response message r for a detour setup.

[0089] The retrieval message s and response message r put the identifier (ID) of message classes, such as a retrieval message and a response message, and a transmission place communication device, the identifier (ID) of a transmitting agency communication device, the identifier (ID) of a failure related communication device, the circuit remaining capacity, etc. on the control section of the frame of a sending signal. A failure related communication device points out the adjoining communication device connected to the transmission line which has generated the communication device which has generated the failure, or the failure.

[0090] If each node detects that the transmission line between the node N1 of the car control section 1 and the node Nn of each motor control section was securable, each node will set the self-motor control section and a self-inverter as a standby condition. When a control command inputs through a transmission line, the self-motor control section controls a self-inverter by the control command.

[Example (a)] For example, the case where communication failure B1 occurs on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .

[0091] By polling between the adjacent nodes N1 through the transmission line and detour transmission line which were connected, a node N2 is detected as a communicative failure, when there is no response from a partner. A message class is the retrieval message s, and the identifier of a transmitting agency communication device is N2, and processing means N2a of a node N2 puts the signal of the purport whose identifier of a failure related communication device is N1 on the control section of a signal frame, and transmits to it a node N13 or N3.

(a-1) Explain a setup of the detour through a node N3 first. If this retrieval message s is received, a node N3 takes out the identifier N1 of a failure related node from the retrieval message s in processing means N3a, and compares this identifier N1 with the data N1, N2, and N10 memorized by the data N3 and adjacent node ID storage section N3c which were memorized by self-node ID storage section N3b. Since an identifier N1 is in agreement with the data N1 memorized by adjacent node ID storage section N3c as a result of this comparison While transmitting response message r to a node N2 so that a node N3 may be connected to the transmission line R1 between a node N2 and a node N1, i.e., a detour transmission-line CR2 -> detour trunk transmission-line CR-> detour transmission-line CR3 -> node N3 -> transmission-line R3 -> transmission line, the path change section of self is received. The routing signal which directs to set up the alternate route to a node N2 via a node N3 instead of the communication path to the node N2 which goes via a transmission line R2 is sent.

[0092] Response message r is the sending signal which put the signal of the purport whose identifier of a transmitting agency node a message class is a response message, the identifier of a transmission place node is N2, and is N3 on the control section of a signal frame.

[0093] If the node N2 which received response message r on the other hand receives response message r,

the signal of the purport whose identifier of a transmitting agency communication device is N3 will be taken out, the node of the partner who should set up an alternate route based on this will be checked, and the routing signal which directs to set up the alternate route to a node N3 as well as the above-mentioned embodiment will be sent to the path change section of self.

(a-2) Explain a setup of the detour through a node N13.

With the procedure explained above (a-1) and the same procedure, the detour connected with the detour transmission-line CR2 -> detour trunk transmission-line CR-> detour transmission-line CR13 -> node N13 -> transmission-line R13 -> transmission line R1 is formed.

[0094] An alternate route is set up based on the above two routing signals.

[Example (b)] For example, the case where the communication failure of B-2 occurs in the communication failure of B1 and the detour trunk transmission line CR on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .

[0095] In this case, only the detour explained above (a-2) can be set up, and the detour explained above (a-1) cannot be set up.

[Example (c)] For example, the case where B-2 and the communication failure of B3 occur in the communication failure of B1 and the detour trunk transmission line CR on the signal-transmission way R2 between the car control section 1 and the motor control section 2 is explained using drawing 1 and drawing 2 .

[0096] In this case, according to B1, B-2, and communication failure generating of B3, when there is no response to polling into predetermined time about all the transmission lines to the car control section 1 having been lost, a node N2 detects a node N2, it changes the standby mode of the motor control section 2 into stop mode, and stops an inverter 10 and 10'.

[0097] The car control section 1 detects that there is no response from a node N2 into predetermined time, separates a node N2 from a propagation circuit, backs it up through the remaining nodes, and controls the remaining motor control section.

[0098] Hereafter, the detour of the car control section 1 and each control sections 2, 3, 4, 5, 10, 11, 12, and 13 is set up like the above-mentioned embodiment.

[0099]

[Effect of the Invention] As mentioned above, according to this invention, the following effectiveness can be done so as explained to the detail.

[0100] (1) The electronics control which can improve transit stability is adopted and it has the wheel system supported in a tandem wheel mounted suspension, and the control action of a car can be continued, maintaining a control function by setting up an alternate route, even if the failure generated each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which built the motor of electronics control into all wheel rings in the specific electronic control system.

[0101] (2) Since the fail-safe device was included in the electronic control system, car control can be carried out to stability. That is, since the support load for every ring can be lessened since the control which can improve transit stability was adopted in each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which has the wheel system supported in a tandem wheel mounted suspension, and built the motor into all wheel rings, and TRC corresponding to it or ABS control can be performed, a slip etc. can be lessened and transit stability can be raised. moreover , since the non-slip ring ordered the left-hand side and right-hand side of a car body at a time at least one output torque value to each motor at a certain time after adjust so that the direction moment of a yaw new into a car body might not act , 8WD(s) can be realize prevent generating of the direction moment of a yaw , and transit stability control with the high dependability at the time of a slip can be realize .

[0102] (3) Since the fail-safe device was included in the electronic control system, car control can be carried out to stability. That is, have the wheel system supported in a tandem wheel mounted suspension, and it sets to each driving wheel independent drive mold electric vehicle equipped with the Inn wheel mounted drive which built the motor into all wheel rings. Since the control which can improve transit stability was adopted, when a slip etc. can be lessened, and transit stability can be raised and one piece

does not have a non-slipping ring in the left-hand side of a car body, either, and when one piece cannot be found in right-hand side, either Since it was ordered output torque value to each motor after adjusting according to the slip condition of a slip ring, Since it can realize and TRC/ABS equivalent control operates TRC/ABS equivalent control without the member for the pressure operated of the fluid for braking under a suitable situation, the transit stability control with the high dependability at the time of a slip is realizable.

[Brief Description of the Drawings]

[Drawing 1] It is the system configuration Fig. of the electric vehicle in which the example of this invention is shown.

[Drawing 2] It is the block diagram of the electronic control system of the electric vehicle in which the example of this invention is shown.

[Drawing 3] It is the flow chart which shows the car-body-speed detection step which shows the example of this invention.

[Drawing 4] It is the flow chart which shows the target yaw rate (whenever [angle-of-slide]) adaptation control step which shows the example of this invention.

[Drawing 5] It is the flow chart which shows the TRC/ABS control step which shows the example of this invention.

[Drawing 6] It is the flow chart which shows the operations sequence of the car control section which shows the example of this invention.

[Drawing 7] It is drawing showing the basic configuration of an electric power automobile.

[Description of Notations]

1 Car Control Section (CPU)
2, 3, 4, 5 Motor control section (CPU)
6 Dc-battery
9 Power Sensor
10, 10', 11, 11', 12, 12', 13, 13' Inverter
14 Brake Sensor
15 Rudder Angle Sensor
16 Shift Position (SP) Switch
17 Accelerator Sensor
18 Temperature Sensor
19 Abnormality Detection Sensor
20 Brake Pedal
21 Master Cylinder
A Cell control section
B Charge control section
C Brake control section
22 Steering Control Section
30, 31, 32, 33, 34, 35, 36, 37 Motor
40 Forward Right Section Front Wheel RFF
41 Forward Right Section Rear Wheel RFR
42 Forward Left Section Front Wheel LFF
43 Forward Left Section Rear Wheel LFR
44 Right Rear Section Front Wheel RRF
45 Right Rear Section Rear Wheel RRR
46 Left Rear Section Front Wheel LRF
47 Left Rear Section Rear Wheel LRR
50, 51, 52, 53, 54, 55, 56, 57 Rotation position sensor (SM)
60, 61, 62, 63, 64, 65, 66, 67 Brake wheel (BW)
VRFF, VRFR, VLFF, VLFR, VRRF, VRRR, VLRF, VLRR Wheel speed
TRF, TLF, TRR, TLR Torque command

CR Detour trunk transmission line for control signals
CR2, CR3, CR4, CR5, CR10, CR11, CR12, CR13 detour transmission line
R1, R2, R3, R4, R5, R10, R11, R12, R13 Transmission line
N1, N2, N3, N4, N5, N10, N11, N12, N13 Node
N1a, N2a, N3a, N4a, N5a, N10a, N11a, N12a, N13a Processing means
N1b, N2b, N3b, N4b, N5b, N10b, N11b, N12b, N13b Self-node ID storage means
N1c, N2c, N3c, N4c, N5c, N10c, N11c, N12c, N13c Adjacent node ID storage means
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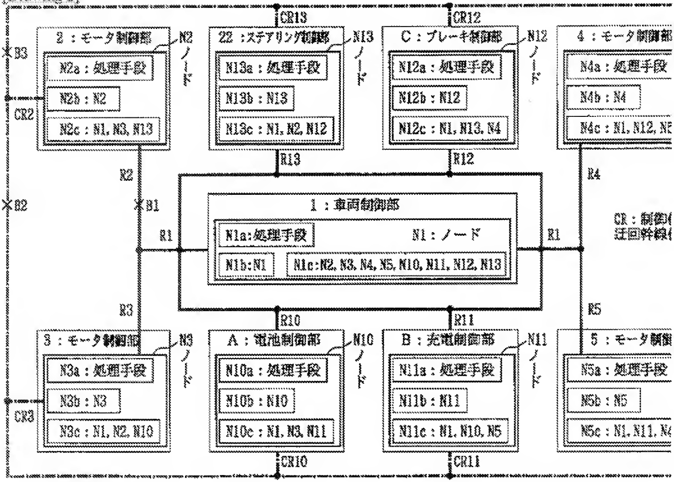
[Item(s) to be Amended] drawing 2
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 2]



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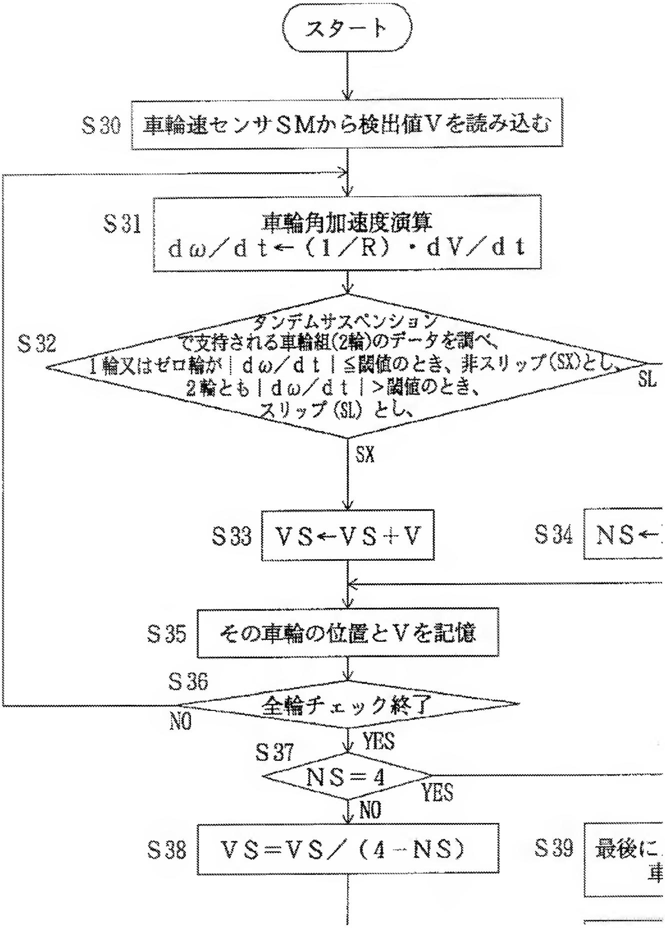
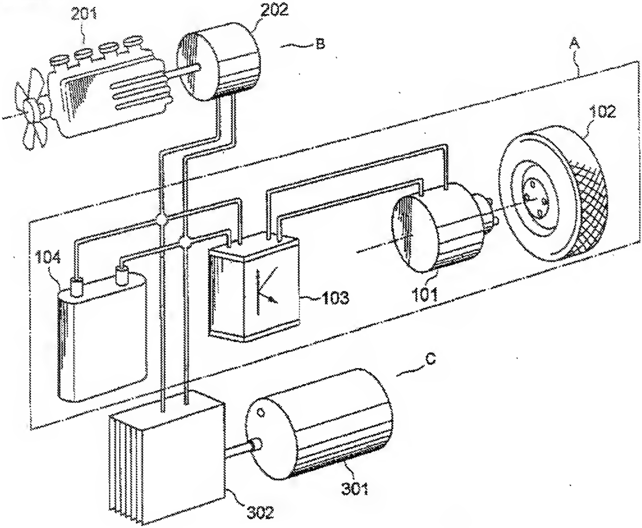
[Item(s) to be Amended] drawing 3
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 3]


スタート
S30
車輪速センサSMから検出値Vを読み込む
S31
車輪角加速度演算
dω／dt←（1／R）・dV／dt
S32
タンデムサスペンション
で支持される車輪組(2輪)のデータを調べ、
1輪又はゼロ輪が｜dω／dt｜≦閾値のとき、非スリップ(SX)とし、
2輪とも｜dω／dt｜>閾値のとき、
スリップ(SL)とし、
SL
SX
S33
VS←VS＋V
S34
NS←
S35
その車輪の位置とVを記憶
S36
全輪チェック終了
NO
YES
S37
NS＝4
YES
NO
S38
VS=VS／（4－NS）
S39
最後に
車

[Procedure amendment 4]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] drawing 7
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 7]



[Translation done.]